

***Appendix E***  
*Soil and Aquifer Testing Data*



**DRISENGA &  
ASSOCIATES, INC.**

**Engineering • Surveying • Testing**

12330 James Street, Suite H80  
Holland, Michigan 49424  
Ph. (616) 396-0255 • Fax (616) 396-0100  
[www.driesenga.com](http://www.driesenga.com)

*Celebrating 20 Years!*  
1995-2015

## TRANSMITTAL

<b>TO:</b> E&E Solutions 200 North Franklin Street Suite 202 Zeeland, Michigan 49464		<b>DATE:</b> December 17, 2015			
<b>ATTN:</b> Blaine Litteral		<b>PROJECT:</b> Ottawa County Farms Landfill			
<b>WE ARE TRANSMITTING:</b>		<input checked="" type="checkbox"/>	<b>HEREWITH</b>	<input type="checkbox"/>	<b>UNDER SEPARATE COVER</b>
<b>QUANTITY</b>	<b>DESCRIPTION</b>				
Six (6)	Hydraulic Conductivity by Flexible Wall Permeameter Test Reports				
<b>ISSUED FOR:</b>		<input type="checkbox"/>	<b>APPROVAL</b>	<input type="checkbox"/>	<b>REVIEW &amp; COMMENT</b>
		<input type="checkbox"/>	<b>INFORMATION</b>	<input type="checkbox"/>	<b>CONSTRUCTION</b>
		<input checked="" type="checkbox"/>	<b>YOUR FILE</b>	<input checked="" type="checkbox"/>	<b>AS REQUESTED</b>
<b>REMARKS:</b>	Please contact me if you have any questions.				
<b>DISTRIBUTION:</b>	File – 1510644.4A				

By: \_\_\_\_\_

James Henning, P.E.  
Director of Testing Services



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## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: E&E Solutions Lab Project #: 1510644.4A  
Project: Ottawa County Farms Landfill Sample #: SB-31  
Date: 11/6/15 Sample Desc.: Brown Clay

### SAMPLE INFORMATION

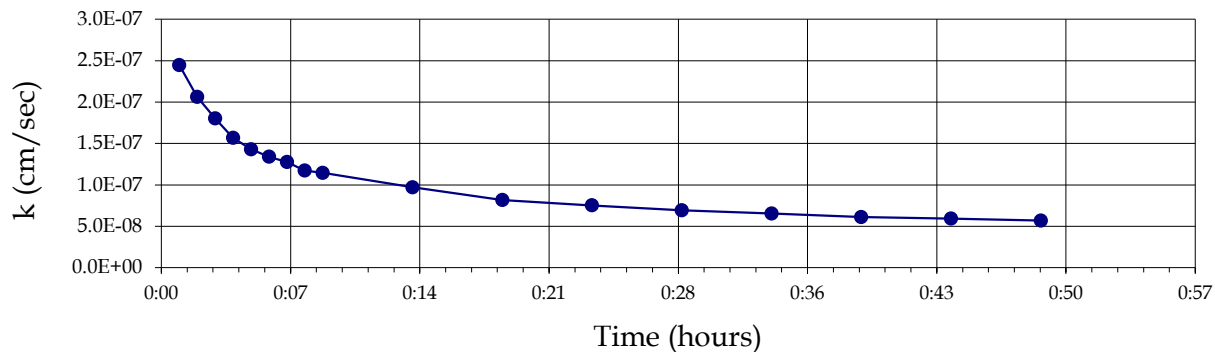
	Initial			Final	
Length:	7.72 cm	3.04 in		7.73 cm	3.04 in
Diameter:	7.23 cm	2.85 in		7.27 cm	2.86 in
Water Content:	18%			20%	
Dry Density:	1.83 g/cc	114.1 pcf		1.78 g/cc	111.2 pcf

Saturation  
(B Coefficient): 0.97

### PERMOMETER TEST

Permeant Liquid: 0.005 N CaSO<sub>4</sub> Back Pressure: 58 psi  
Hydraulic gradient: 24.6 to 35.8 Effective Consolidation: 2 psi

Hydraulic Conductivity VS Time



Average Stabilized Hydraulic Conductivity k: **5.8E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis

## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: <u>E&amp;E Solutions</u>	Lab Project #: <u>1510644.4A</u>
Project: <u>Ottawa County Farms Landfill</u>	Sample #: <u>SB-33 (48'-50')</u>
Date: <u>11/19/15</u>	Sample Desc.: <u>Brown Clay, Trace Silt, Trace Coarse Sand/Fine Gravel</u>

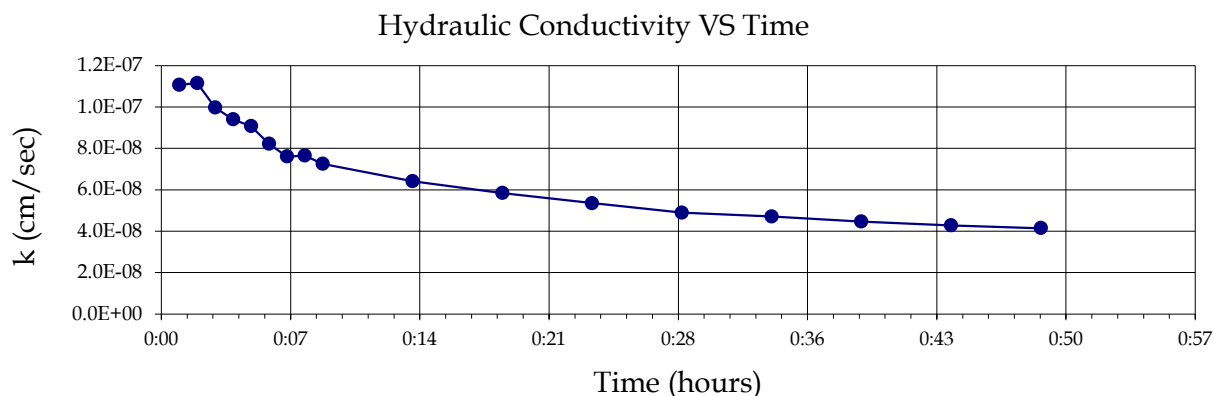
### SAMPLE INFORMATION

	Initial	Final
Length:	6.99 cm      2.75 in	7.03 cm      2.77 in
Diameter:	7.22 cm      2.84 in	7.25 cm      2.85 in
Water Content:	25%	
Dry Density:	1.64 g/cc      102.3 pcf	1.62 g/cc      101.2 pcf

Saturation  
(B Coefficient): 0.96

### PERMOMETER TEST

Permeant Liquid: <u>0.005 N CaSO<sub>4</sub></u>	Back Pressure: <u>58 psi</u>
Hydraulic gradient: <u>29.0</u> to <u>39.3</u>	Effective Consolidation: <u>2 psi</u>



Average Stabilized Hydraulic Conductivity k: **4.2E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis





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1995-2015

## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: E&E Solutions  
Project: Ottawa County Farms Landfill  
Date: 11/20/15

Lab Project #: 1510644.4A  
Sample #: SB-35 (42'-44')  
Sample Desc.: Brown Clay, Trace Silt, Trace Coarse Sand/Fine Gravel

### SAMPLE INFORMATION

	Initial			Final	
Length:	7.12 cm	2.80 in		7.12 cm	2.80 in
Diameter:	7.26 cm	2.86 in		7.25 cm	2.85 in
Water Content:	16%			17%	
Dry Density:	1.90 g/cc	118.6 pcf		1.91 g/cc	118.9 pcf

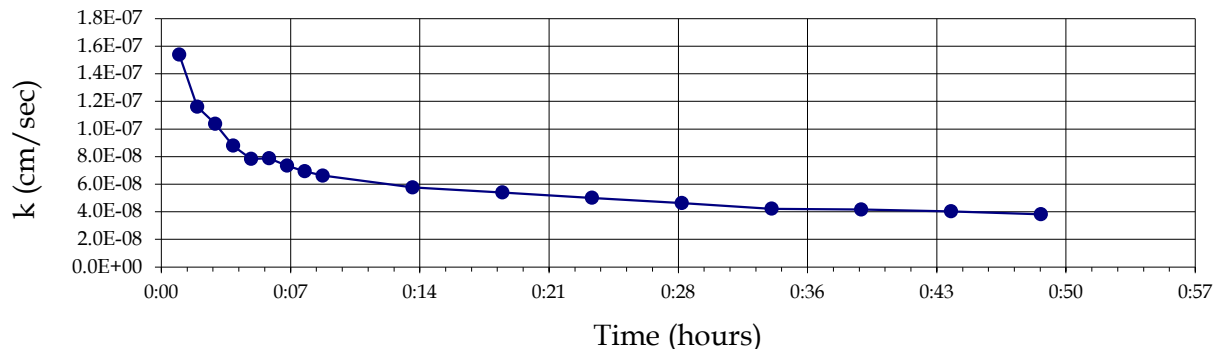
Saturation  
(B Coefficient): 0.96

### PERMOMETER TEST

Permeant Liquid: 0.005 N CaSO<sub>4</sub>  
Hydraulic gradient: 28.3 to 37.4

Back Pressure: 58 psi  
Effective Consolidation: 2 psi

Hydraulic Conductivity VS Time



Average Stabilized Hydraulic Conductivity k: **3.9E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis

## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: <u>E&amp;E Solutions</u>	Lab Project #: <u>1510644.4A</u>
Project: <u>Ottawa County Farms Landfill</u>	Sample #: <u>SB-37 (42-44')</u>
Date: <u>11/23/15</u>	Sample Desc.: <u>Brown Clay, Trace Silt, Trace Coarse Sand/Fine Gravel</u>

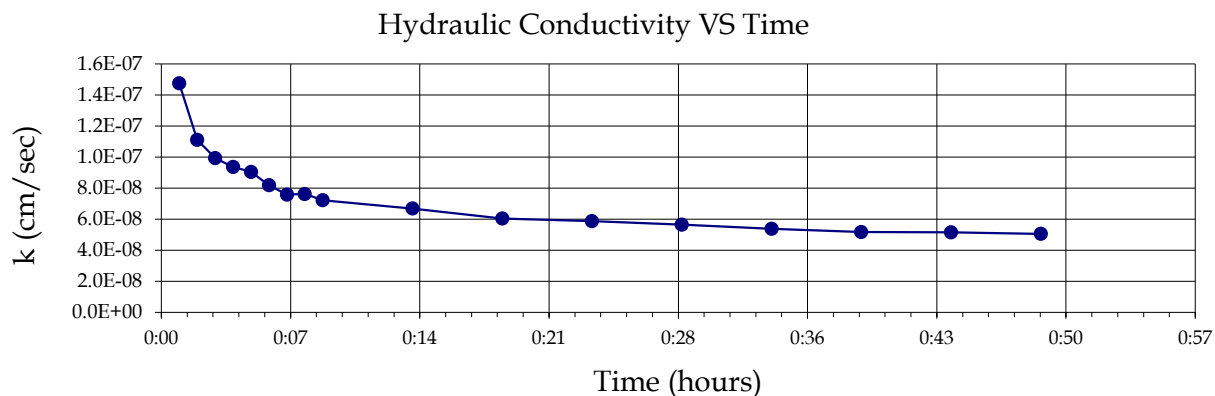
### SAMPLE INFORMATION

	Initial			Final	
Length:	7.08 cm	2.79 in		7.08 cm	2.79 in
Diameter:	7.24 cm	2.85 in		7.26 cm	2.86 in
Water Content:	22%			23%	
Dry Density:	1.69 g/cc	105.5 pcf		1.68 g/cc	104.6 pcf

Saturation  
(B Coefficient): 0.97

### PERMOMETER TEST

Permeant Liquid: <u>0.005 N CaSO<sub>4</sub></u>	Back Pressure: <u>58 psi</u>
Hydraulic gradient: <u>27.1</u> to <u>39.2</u>	Effective Consolidation: <u>2 psi</u>



Average Stabilized Hydraulic Conductivity k: **5.1E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis

## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: E&E Solutions  
Project: Ottawa County Farms Landfill  
Date: 11/24/15

Lab Project #: 1510644.4A  
Sample #: SB-38 (50-52')  
Sample Desc.: Brown Clay, Trace Silt, Trace Coarse Sand/Fine Gravel

### SAMPLE INFORMATION

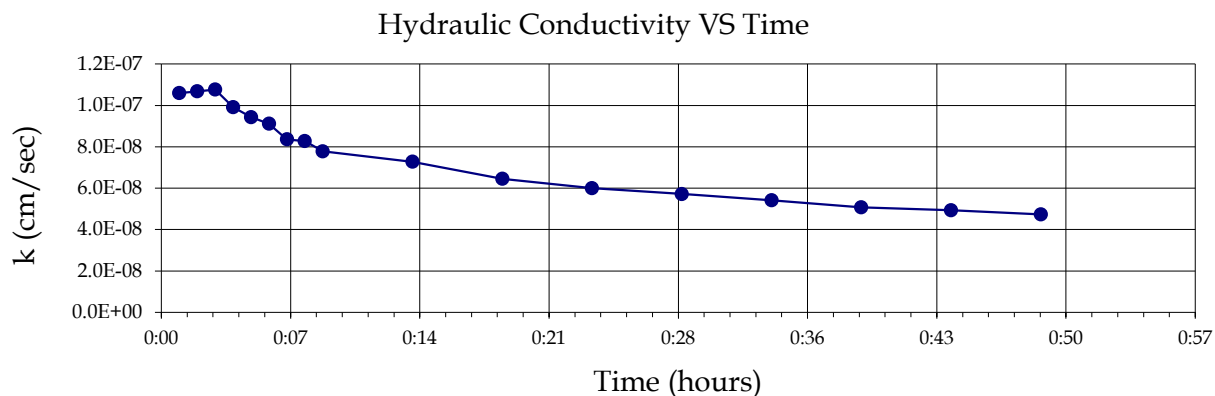
	Initial			Final	
Length:	6.76 cm	2.66 in		6.80 cm	2.68 in
Diameter:	7.13 cm	2.81 in		7.19 cm	2.83 in
Water Content:	21%			21%	
Dry Density:	1.80 g/cc	112.1 pcf		1.77 g/cc	110.3 pcf

Saturation  
(B Coefficient): 0.97

### PERMOMETER TEST

Permeant Liquid: 0.005 N CaSO<sub>4</sub>  
Hydraulic gradient: 29.6 to 42.1

Back Pressure: 58 psi  
Effective Consolidation: 2 psi



Average Stabilized Hydraulic Conductivity k: 4.9E-08 cm/sec

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis

## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: <u>E&amp;E Solutions</u>	Lab Project #: <u>1510644.4A</u>
Project: <u>Ottawa County Farms Landfill</u>	Sample #: <u>SB-40</u>
Date: <u>12/14/15</u>	Sample Desc.: <u>Brown Clay, Trace Silt, Trace Gravel</u>

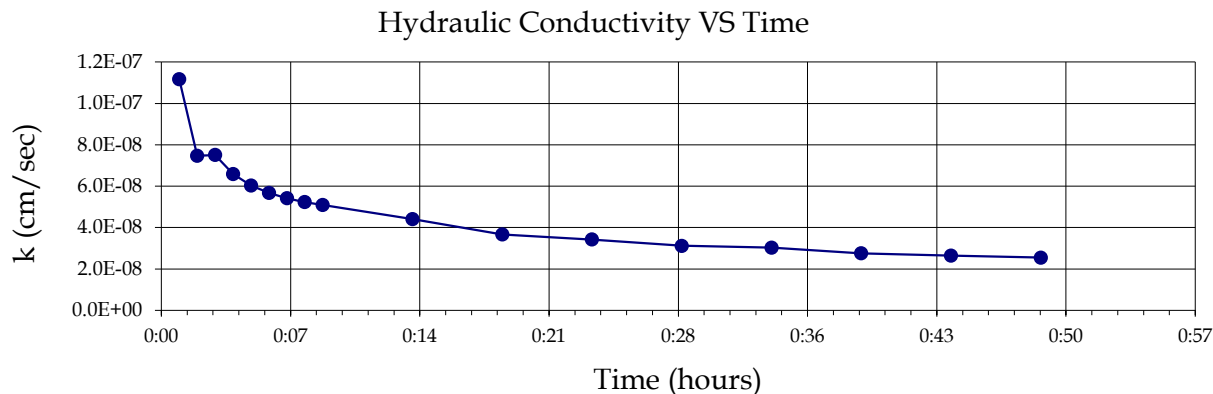
### SAMPLE INFORMATION

	Initial		Final	
Length:	7.35 cm	2.89 in	7.42 cm	2.92 in
Diameter:	7.24 cm	2.85 in	7.19 cm	2.83 in
Water Content:	15%		15%	
Dry Density:	1.96 g/cc	122.0 pcf	1.98 g/cc	123.8 pcf

Saturation  
(B Coefficient): 0.95

### PERMOMETER TEST

Permeant Liquid: <u>0.005 N CaSO<sub>4</sub></u>	Back Pressure: <u>58 psi</u>
Hydraulic gradient: <u>32.4</u> to <u>38.8</u>	Effective Consolidation: <u>2 psi</u>



Average Stabilized Hydraulic Conductivity k: **2.6E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis



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## TRANSMITTAL

<b>TO:</b> E&E Solutions 400 136 <sup>th</sup> Avenue Suite B Holland, Michigan 49424		<b>DATE:</b> February 19, 2016			
<b>ATTN:</b> Blaine Litteral		<b>PROJECT:</b> Ottawa County Farms Landfill			
<b>WE ARE TRANSMITTING:</b>		<input checked="" type="checkbox"/>	<b>HEREWITH</b>	<input type="checkbox"/>	<b>UNDER SEPARATE COVER</b>
<b>QUANTITY</b>	<b>DESCRIPTION</b>				
Six (6)	Hydraulic Conductivity by Flexible Wall Permeameter Test Reports				
<b>ISSUED FOR:</b>		<input type="checkbox"/>	<b>APPROVAL</b>	<input type="checkbox"/>	<b>REVIEW &amp; COMMENT</b>
		<input type="checkbox"/>	<b>INFORMATION</b>	<input type="checkbox"/>	<b>CONSTRUCTION</b>
		<input checked="" type="checkbox"/>	<b>YOUR FILE</b>	<input checked="" type="checkbox"/>	<b>AS REQUESTED</b>
<b>REMARKS:</b>	Please contact me if you have any questions.				
<b>DISTRIBUTION:</b>	Kurt VanAppledorn – E&E Solutions File – 1510644.4A				

By: \_\_\_\_\_

James Henning, P.E.  
Director of Testing Services



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## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: <u>E&amp;E Solutions</u>	Lab Project #: <u>1510644.4A</u>
Project: <u>Ottawa County Farms Landfill</u>	Sample #: <u>DB-25 (75'-77')</u>
Date: <u>2/4/16</u>	Sample Desc.: <u>Brown Clay, Trace Silt</u>

### SAMPLE INFORMATION

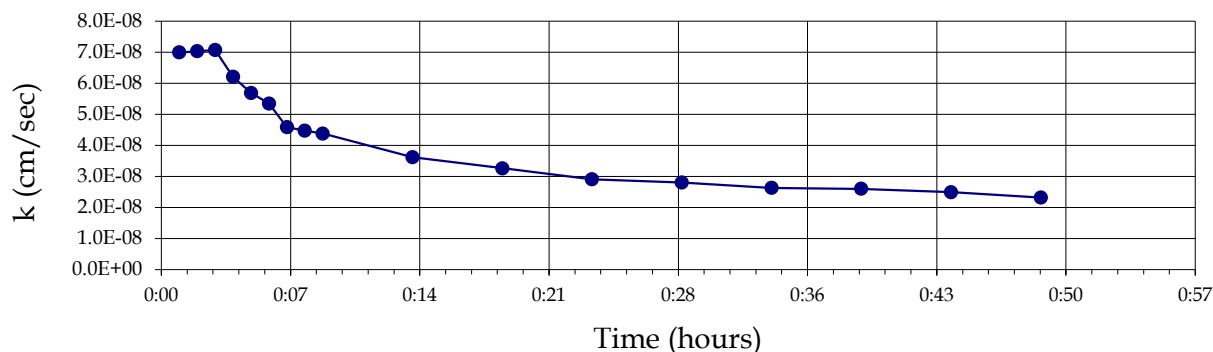
	Initial			Final	
Length:	6.65 cm	2.62 in		6.67 cm	2.63 in
Diameter:	7.24 cm	2.85 in		7.27 cm	2.86 in
Water Content:	15%			15%	
Dry Density:	1.93 g/cc	120.6 pcf		1.92 g/cc	120.0 pcf

Saturation  
(B Coefficient): 0.96

### PERMOMETER TEST

Permeant Liquid: <u>0.005 N CaSO<sub>4</sub></u>	Back Pressure: <u>58 psi</u>
Hydraulic gradient: <u>34.3</u> to <u>41.1</u>	Effective Consolidation: <u>2 psi</u>

Hydraulic Conductivity VS Time



Average Stabilized Hydraulic Conductivity k: **2.4E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis



**HYDRAULIC CONDUCTIVITY  
FLEXIBLE WALL PERMEABILITY USING MERCURY**

(ASTM D5084)

**PROJECT INFORMATION**

Client: E&E Solutions  
Project: Ottawa County Farms Landfill  
Date: 2/5/16

Lab Project #: 1510644.4A  
Sample #: DB-26 (41'-43')  
Sample Desc.: Brown Clay, Trace Silt

**SAMPLE INFORMATION**

	Initial			Final	
Length:	6.96 cm	2.74 in		6.96 cm	2.74 in
Diameter:	7.16 cm	2.82 in		7.19 cm	2.83 in
Water Content:	24%			27%	
Dry Density:	1.64 g/cc	102.4 pcf		1.60 g/cc	100.0 pcf

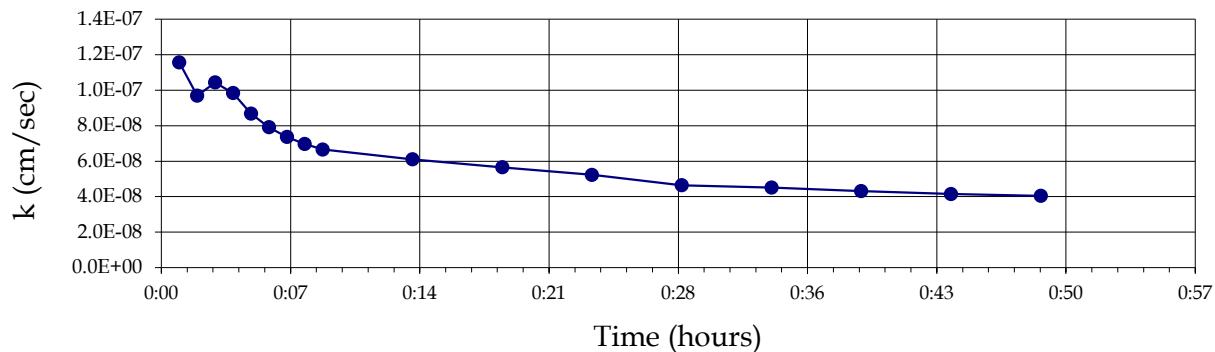
Saturation  
(B Coefficient): 0.99

**PERMOMETER TEST**

Permeant Liquid: 0.005 N CaSO<sub>4</sub>  
Hydraulic gradient: 28.5 to 38.3

Back Pressure: 58 psi  
Effective Consolidation: 2 psi

Hydraulic Conductivity VS Time



Average Stabilized Hydraulic Conductivity k: **4.1E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis



## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: <u>E&amp;E Solutions</u>	Lab Project #: <u>1510644.4A</u>
Project: <u>Ottawa County Farms Landfill</u>	Sample #: <u>DB-26 (43'-45')</u>
Date: <u>2/10/16</u>	Sample Desc.: <u>Soft Brown Clay, Trace Silt</u>

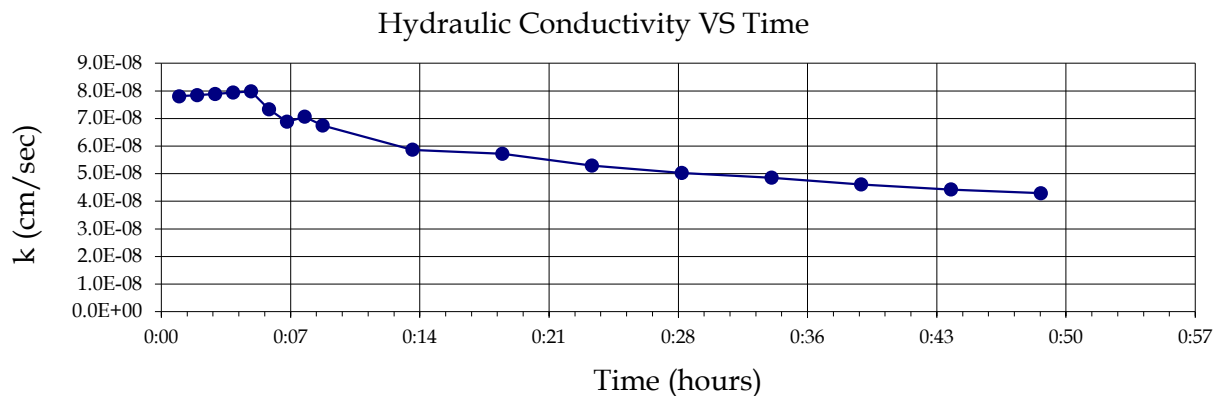
### SAMPLE INFORMATION

	Initial		Final	
Length:	6.85 cm	2.70 in	6.80 cm	2.68 in
Diameter:	6.94 cm	2.73 in	7.03 cm	2.77 in
Water Content:	26%		26%	
Dry Density:	1.70 g/cc	105.9 pcf	1.65 g/cc	103.2 pcf

Saturation  
(B Coefficient): 0.96

### PERMOMETER TEST

Permeant Liquid: <u>0.005 N CaSO<sub>4</sub></u>	Back Pressure: <u>58 psi</u>
Hydraulic gradient: <u>29.8</u> to <u>40.1</u>	Effective Consolidation: <u>2 psi</u>



Average Stabilized Hydraulic Conductivity k: **4.4E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis



## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: E&E Solutions  
Project: Ottawa County Farms Landfill  
Date: 2/3/16

Lab Project #: 1510644.4A  
Sample #: M-21 (45'-47')  
Sample Desc.: Brown Clay, Trace Silt

### SAMPLE INFORMATION

	Initial			Final	
Length:	6.69 cm	2.63 in		6.72 cm	2.65 in
Diameter:	7.16 cm	2.82 in		7.15 cm	2.81 in
Water Content:	24%			24%	
Dry Density:	1.65 g/cc	102.7 pcf		1.66 g/cc	103.9 pcf

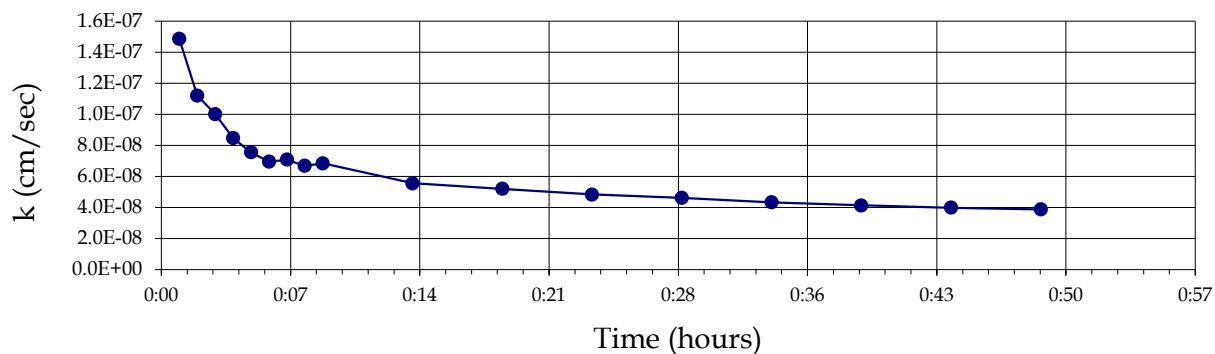
Saturation  
(B Coefficient): 0.97

### PERMOMETER TEST

Permeant Liquid: 0.005 N CaSO<sub>4</sub>  
Hydraulic gradient: 29.9 to 39.8

Back Pressure: 58 psi  
Effective Consolidation: 2 psi

Hydraulic Conductivity VS Time



Average Stabilized Hydraulic Conductivity k: **3.9E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis



## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: E&E Solutions  
Project: Ottawa County Farms Landfill  
Date: 2/4/16

Lab Project #: 1510644.4A  
Sample #: M-21 (47'-49')  
Sample Desc.: Brown Clay, Trace Silt

### SAMPLE INFORMATION

	Initial		Final	
Length:	6.97 cm	2.74 in	6.99 cm	2.75 in
Diameter:	7.24 cm	2.85 in	7.23 cm	2.85 in
Water Content:	23%		23%	
Dry Density:	1.70 g/cc	106.0 pcf	1.71 g/cc	106.5 pcf

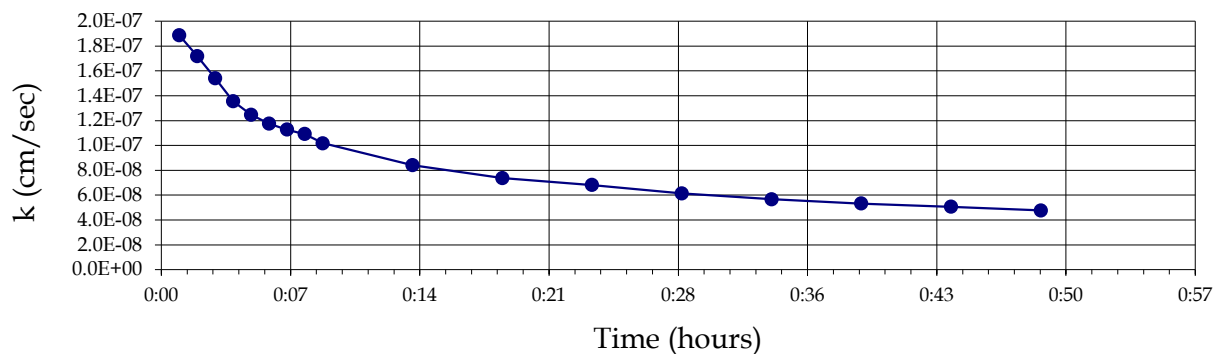
Saturation  
(B Coefficient): 0.97

### PERMOMETER TEST

Permeant Liquid: 0.005 N CaSO<sub>4</sub>  
Hydraulic gradient: 27.3 to 38.4

Back Pressure: 58 psi  
Effective Consolidation: 2 psi

Hydraulic Conductivity VS Time



Average Stabilized Hydraulic Conductivity k: **4.9E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis

## HYDRAULIC CONDUCTIVITY FLEXIBLE WALL PERMEABILITY USING MERCURY

(ASTM D5084)

### PROJECT INFORMATION

Client: <u>E&amp;E Solutions</u>	Lab Project #: <u>1510644.4A</u>
Project: <u>Ottawa County Farms Landfill</u>	Sample #: <u>SB-41 (38'-40')</u>
Date: <u>2/11/16</u>	Sample Desc.: <u>Brown Clay, Trace Silt</u>

### SAMPLE INFORMATION

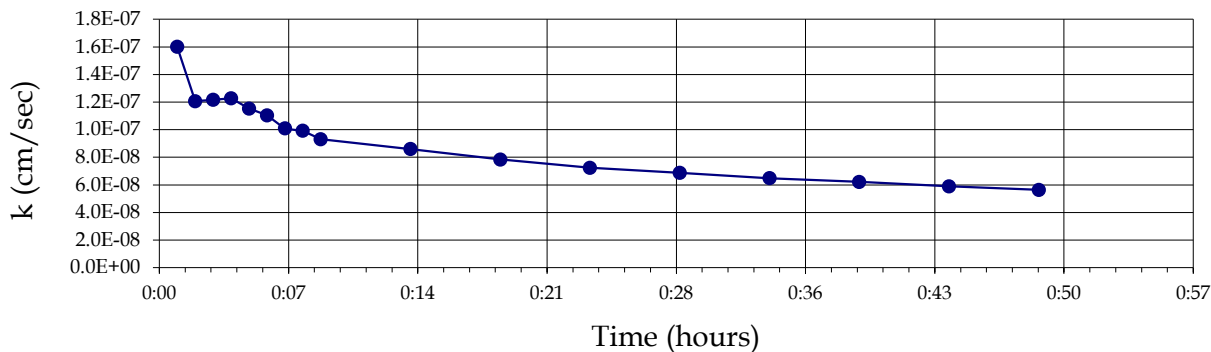
	Initial			Final	
Length:	7.32 cm	2.88 in		7.35 cm	2.89 in
Diameter:	7.20 cm	2.83 in		7.28 cm	2.87 in
Water Content:	23%			23%	
Dry Density:	1.74 g/cc	108.8 pcf		1.71 g/cc	106.7 pcf

Saturation  
(B Coefficient): 0.98

### PERMOMETER TEST

Permeant Liquid: <u>0.005 N CaSO<sub>4</sub></u>	Back Pressure: <u>58 psi</u>
Hydraulic gradient: <u>24.8</u> to <u>36.6</u>	Effective Consolidation: <u>2 psi</u>

Hydraulic Conductivity VS Time



Average Stabilized Hydraulic Conductivity k: **5.8E-08 cm/sec**

Remarks: Sample was extracted from shelly tube, trimmed, and mounted prior to analysis

# Soil Classification Report

## Project Information

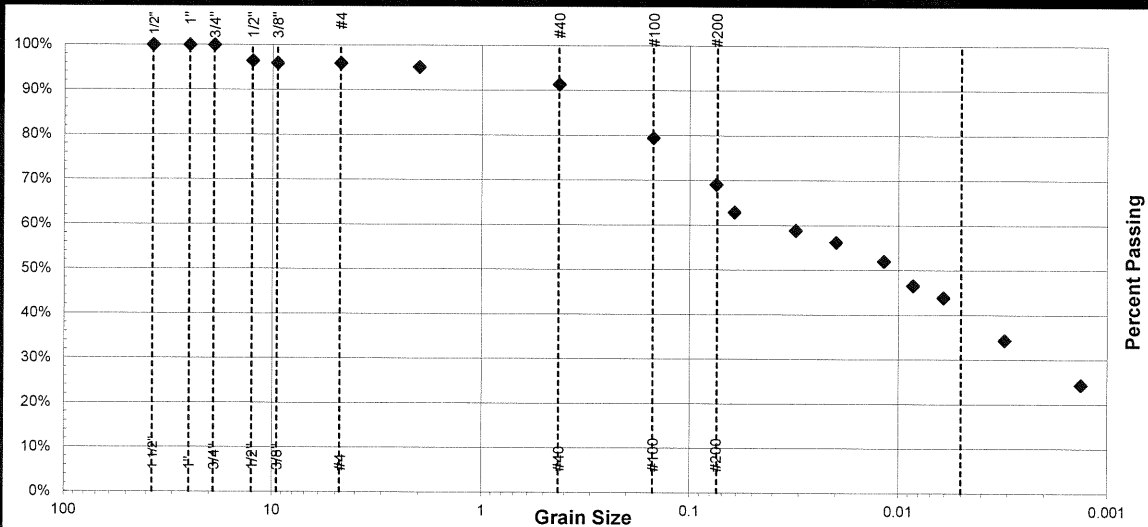
Sample ID: 16-0012  
Lab ID: SB-32  
Sampled By: ARM  
Sample Date: 10/8/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 9-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
2.0%	2.0%	0.8%	3.7%	22.3%	69.1%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description		
1 1/2"	0.0	100.0%			
1"	0.0	100.0%			
1/2"	4.3	98.0%	Coefficients		
3/8"	4.4	96.0%			
#4	0.0	96.0%	D <sub>60</sub> :	0.0462	
#10	1.8	95.1%	D <sub>30</sub> :	0.0022	Cc: 0.09 Cu: 38.50
#40	8.1	91.4%	D <sub>10</sub> :	0.0012	
#100	25.7	79.5%	Atterberg Limits		
#200	22.4	69.1%			
Pan	1.8		Liquid Limit:	19	
LBW	147.0		Plastic Limit:	14	
TOTAL	215.4		Plasticity Index:	5	
			CLASSIFICATION		
			Lean Clay with Sand		
			CL		

Engineering & Environmental Solutions  
400 136th Avenue Building 100, Suite B Holland MI, 49424  
www.goEESolutions.com

# Soil Classification Report

## Project Information

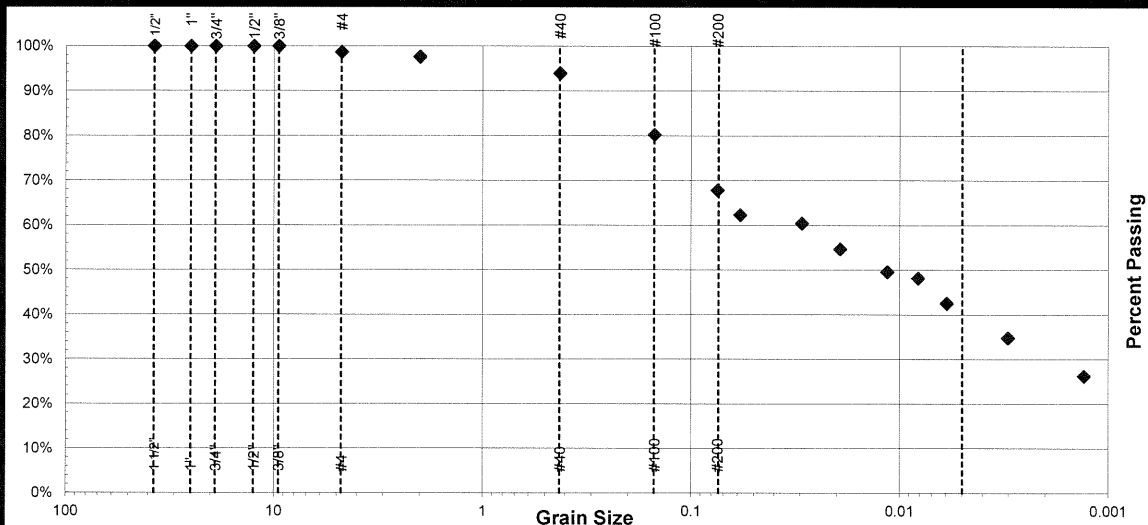
Sample ID: 16-003  
Lab ID: SB-33  
Sampled By: ARM  
Sample Date: 10/8/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Field Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 27-Jan-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	1.3%	1.1%	3.6%	26.1%	67.9%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Brownish Gray Clay 56'-58' Deep			
1"	0.0	100.0%				
3/4"	0.0	100.0%				
3/8"	0.0	100.0%	Coefficients			
#4	2.8	98.7%				
#10	2.3	97.6%				
#40	7.8	94.0%	Atterberg Limits			
#100	29.4	80.3%				
#200	26.6	67.9%				
Pan	4.7		CLASSIFICATION			
LBW	140.6					
TOTAL	214.2					
			Sandy Lean Clay			
			CL			

# Soil Classification Report

## Project Information

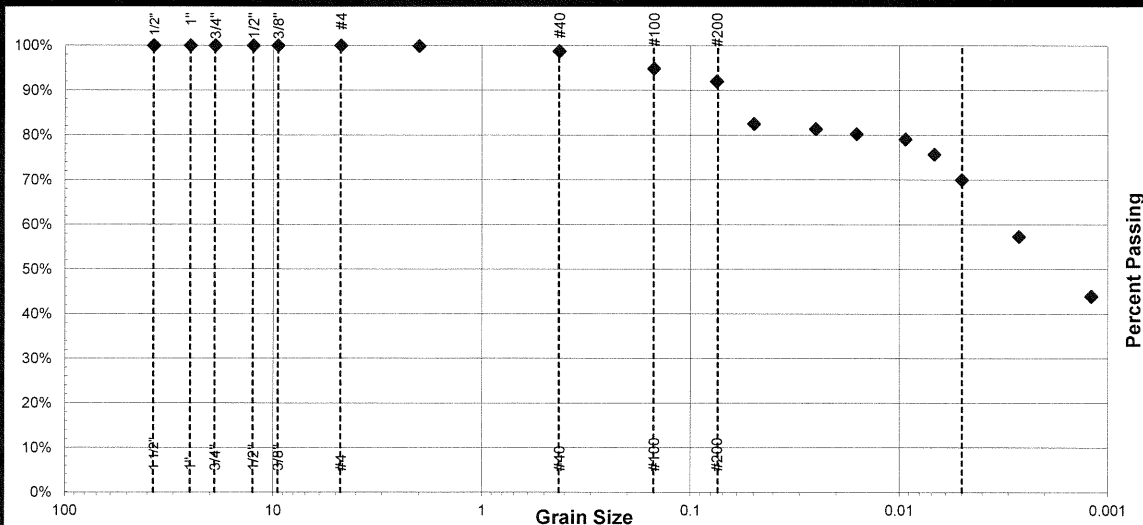
Sample ID: 16-003  
Lab ID: SB-34  
Sampled By: KJV  
Sample Date: 10/12/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 27-Jan-16

Checked By: KJV  
Check Date: 12-Oct-15

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	0.0%	0.1%	1.1%	6.7%	92.0%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Brownish Gray Clay 56'-58' Deep			
1"	0.0	100.0%				
3/4"	0.0	100.0%	Coefficients			
3/8"	0.0	100.0%				
#4	0.0	100.0%				
#10	0.2	99.9%	Atterberg Limits			
#40	2.3	98.8%				
#100	7.7	94.9%				
#200	5.7	92.0%	CLASSIFICATION			
Pan	0.3					
LBW	184.1					
TOTAL	200.3		Lean Clay			
			CL			

# Soil Classification Report

## Project Information

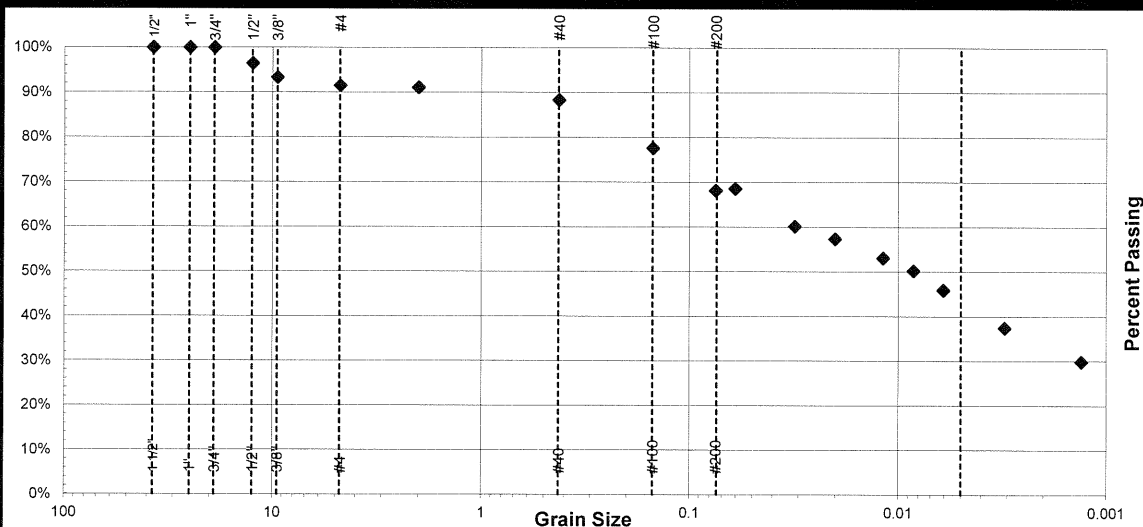
Sample ID: 16-011  
Lab ID: SB-31  
Sampled By: ARM  
Sample Date: 10/9/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 9-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
5.8%	2.6%	0.5%	2.7%	20.2%	68.2%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Dark Grayish Brown Clay 58'-60' Deep			
1"	0.0	100.0%				
1/2"	11.5	94.2%				
3/8"	1.6	93.4%	Coefficients			
#4	3.6	91.6%	D <sub>60</sub> :	0.0314		
#10	1.0	91.0%	D <sub>30</sub> :	0.00132	Cc:	0.04
#40	5.3	88.4%	D <sub>10</sub> :	0.00132	Cu:	23.79
#100	21.2	77.7%	Atterberg Limits			
#200	18.7	68.2%	Liquid Limit:		19	
Pan	1.4		Plastic Limit:		14	
LBW	133.4		Plasticity Index:		5	
TOTAL	197.6		CLASSIFICATION			
			Lean Clay with Sand			
			CL			

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# Soil Classification Report

## Project Information

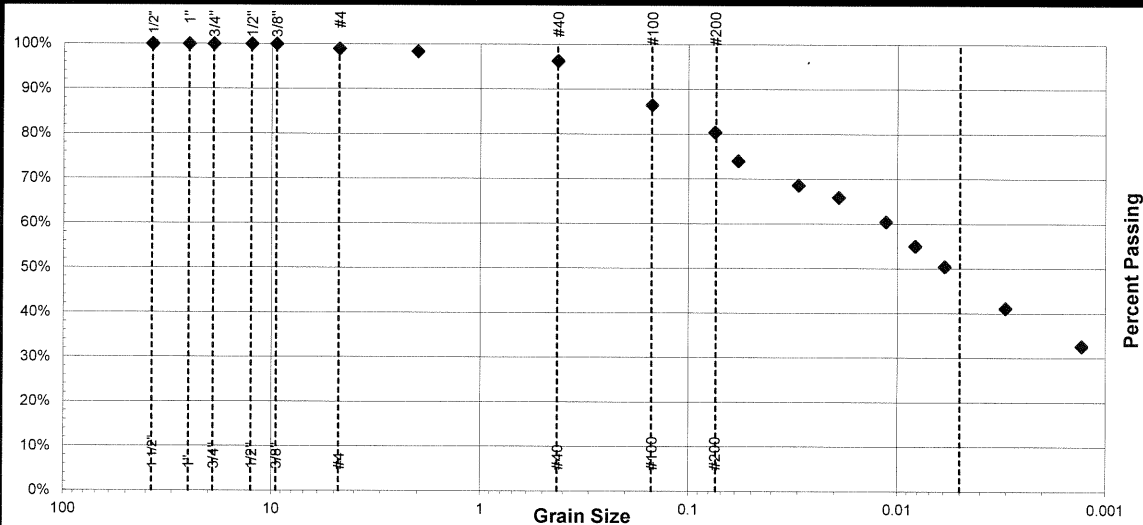
Sample ID: 16-021  
Lab ID: DB-24  
Sampled By: KJV  
Sample Date: 10/29/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 3-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	1.0%	0.6%	2.1%	15.8%	80.5%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description					
1 1/2"	0.0	100.0%	Dark Grayish Brown Clay 89'-91' Deep					
1"	0.0	100.0%						
3/4"	0.0	100.0%						
3/8"	0.0	100.0%	Coefficients					
#4	1.6	99.0%	D <sub>60</sub> :	0.0113	Cc:	0.12	Cu:	8.69
#10	0.9	98.4%	D <sub>30</sub> :	0.0013				
#40	3.2	96.3%	D <sub>10</sub> :	0.0013				
#100	15.1	86.5%	Atterberg Limits					
#200	9.3	80.5%	Liquid Limit:		28			
Pan	1.3		Plastic Limit:		12			
			Plasticity Index:		16			
LBW	122.2		CLASSIFICATION					
TOTAL	153.5		Lean Clay with Sand					
			CL					

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# Soil Classification Report

## Project Information

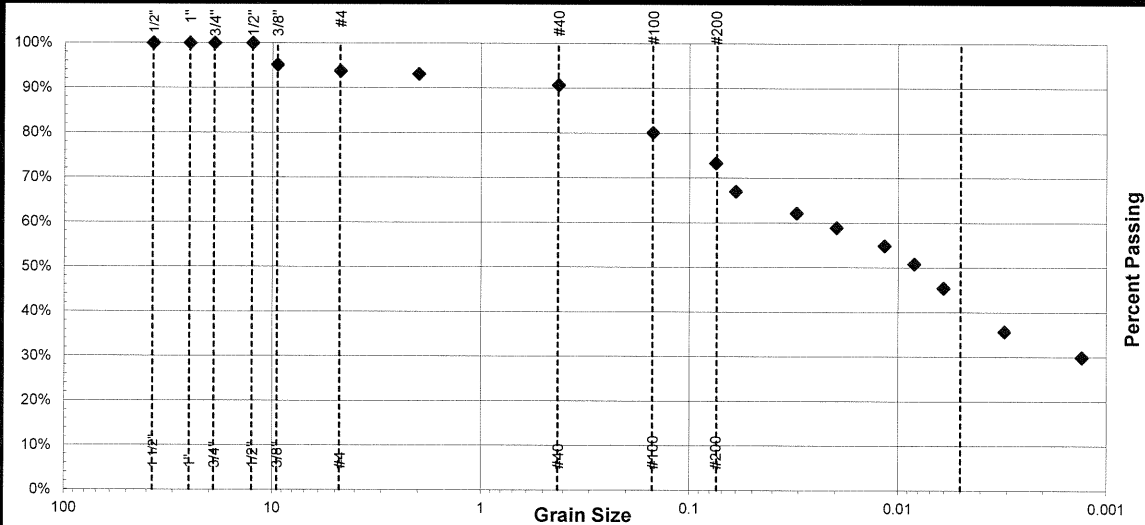
Sample ID: 16-022  
Lab ID: DB-25  
Sampled By: KJV  
Sample Date: 11/4/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 3-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	6.2%	0.8%	2.3%	17.4%	73.3%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description					
1 1/2"	0.0	100.0%	Dark Grayish Brown Clay 84'-86' Deep					
1"	0.0	100.0%						
3/4"	0.0	100.0%						
3/8"	7.3	95.2%	Coefficients					
#4	2.1	93.8%	D <sub>60</sub> :	0.025	Cc:	0.05	Cu:	19.23
#10	1.2	93.0%	D <sub>30</sub> :	0.0013				
#40	3.4	90.7%	D <sub>10</sub> :	0.0013				
#100	16.1	80.1%	Atterberg Limits					
#200	10.3	73.3%	Liquid Limit:		27			
Pan	1.8		Plastic Limit:		11			
LBW	109.0		Plasticity Index:		16			
TOTAL	151.2		CLASSIFICATION					
			Lean Clay with Sand					
			CL					

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# Soil Classification Report

## Project Information

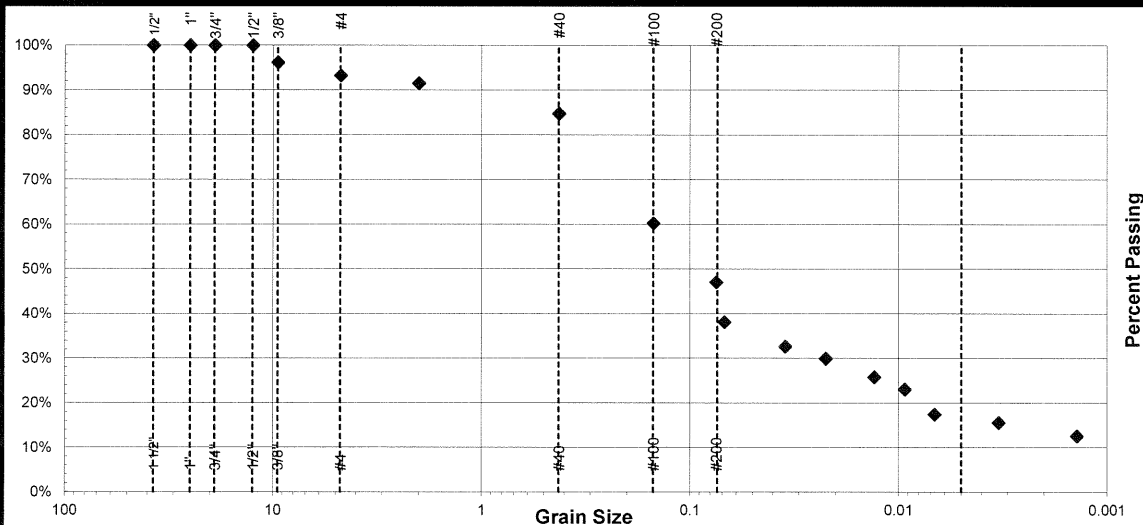
Sample ID: 16-023  
Lab ID: DB-26  
Sampled By: KJV  
Sample Date: 11/10/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 4-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	6.7%	2.2%	6.2%	37.7%	47.1%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description					
1 1/2"	0.0	100.0%	Dark Grayish Brown Clay 104'-106'					
1"	0.0	100.0%						
3/4"	0.0	100.0%						
3/8"	9.5	96.2%	Coefficients					
#4	7.3	93.3%	D <sub>60</sub> :	0.15	Cc:	2.48	Cu:	115.38
#10	5.6	91.0%	D <sub>30</sub> :	0.022				
#40	15.5	84.8%	D <sub>10</sub> :	0.0013				
#100	61.1	60.2%	Atterberg Limits					
#200	32.9	47.1%	Liquid Limit:				17	
Pan	4.6		Plastic Limit:				9	
			Plasticity Index:				8	
LBW	112.7		CLASSIFICATION					
TOTAL	249.2		Clayey Sand					
			SC					

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# Soil Classification Report

## Project Information

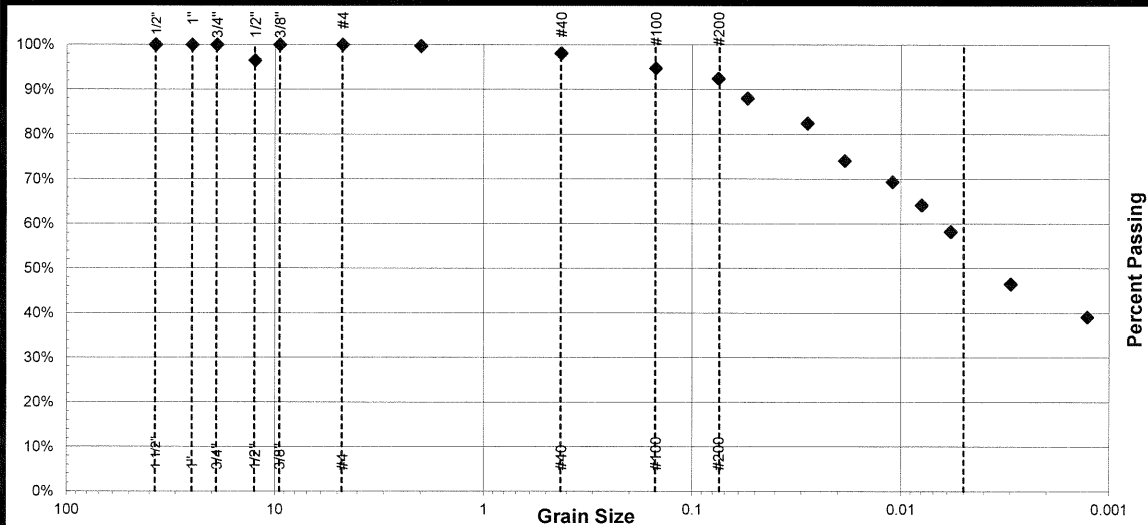
Sample ID: 16-024  
Lab ID: DB-27  
Sampled By: KJV  
Sample Date: 10/27/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 10-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	0.0%	0.3%	1.6%	5.6%	92.5%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Dark Grayish Brown Clay 131'-133' Deep			
1"	0.0	100.0%				
1/2"	0.0	100.0%				
3/8"	0.0	100.0%	Coefficients			
#4	0.0	100.0%	D <sub>60</sub> :	0.00687		
#10	0.7	99.7%	D <sub>30</sub> :	0.00127	Cc:	0.18
#40	3.6	98.1%	D <sub>10</sub> :	0.00127	Cu:	5.41
#100	7.6	94.8%	Atterberg Limits			
#200	5.2	92.5%	Liquid Limit:		26	
Pan	0.8		Plastic Limit:		14	
LBW	208.8		Plasticity Index:		12	
TOTAL	226.6		CLASSIFICATION			
			Fat Clay			
			CH			

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# Soil Classification Report

## Project Information

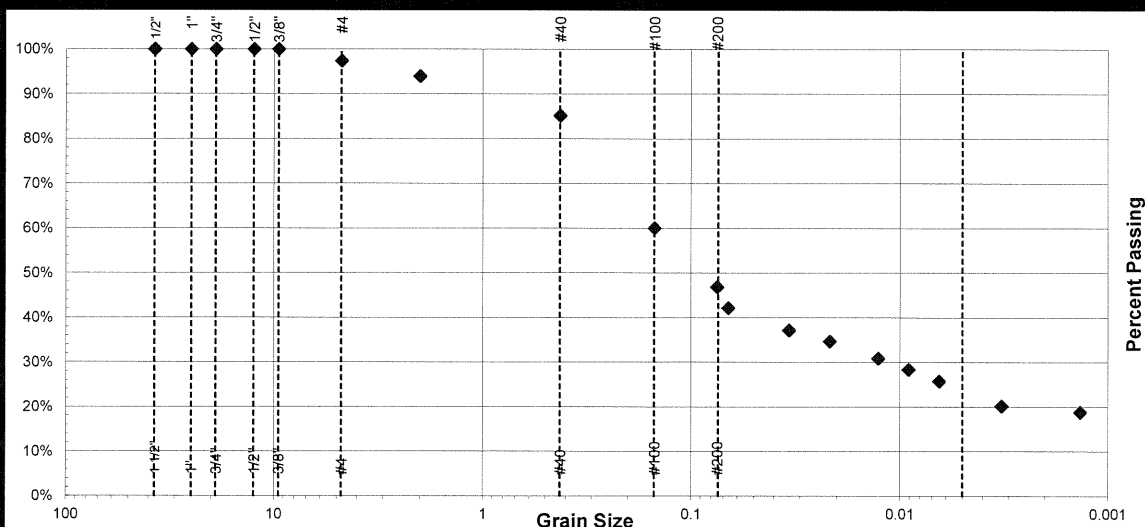
Sample ID: 16-025  
Lab ID: DB-28  
Sampled By: KJV  
Sample Date: 10/15/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 4-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	2.6%	3.5%	8.7%	38.3%	46.9%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
			Dark Grayish Brown Clay 163'-165' Deep			
1 1/2"	0.0	100.0%				
1"	0.0	100.0%				
3/4"	0.0	100.0%				
3/8"	0.0	100.0%	Coefficients			
#4	6.3	97.4%	D <sub>60</sub> :	0.15		
#10	8.5	93.9%	D <sub>30</sub> :	0.0127	Cc:	0.83
#40	21.3	85.2%			Cu:	115.38
#100	61.3	60.1%	D <sub>10</sub> :	0.0013		
#200	32.2	46.9%	Atterberg Limits			
Pan	3.5		Liquid Limit:		17	
			Plastic Limit:		8	
LBW	111.0		Plasticity Index:		9	
TOTAL	244.1		CLASSIFICATION			
			Clayey Sand			
			SC			

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# Soil Classification Report

## Project Information

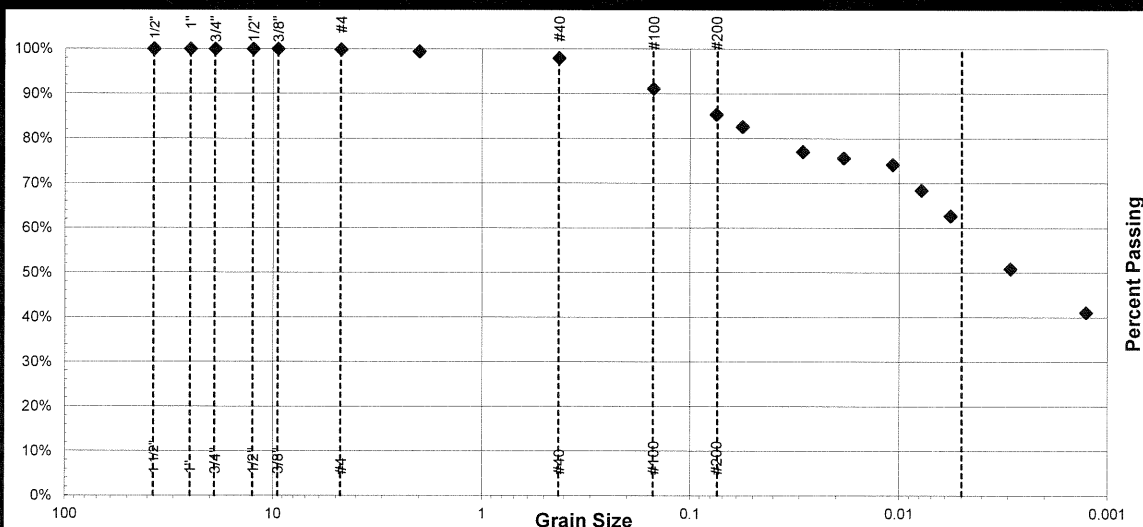
Sample ID: 16-003  
Lab ID: SB-35  
Sampled By: ARM  
Sample Date: 10/7/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 28-Jan-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	0.1%	0.4%	1.4%	12.6%	85.4%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Dark Grayish Brown Clay 48'-50' Deep			
1"	0.0	100.0%				
3/4"	0.0	100.0%				
3/8"	0.0	100.0%	Coefficients			
#4	0.3	99.9%	D <sub>60</sub> : 0.0054	Cc: 0.22	Cu: 4.50	
#10	0.9	99.4%	D <sub>30</sub> : 0.0012			
#40	2.9	98.0%	D <sub>10</sub> : 0.0012			
#100	13.9	91.1%	Atterberg Limits			
#200	11.7	85.4%	Liquid Limit:		32	
Pan	0.0		Plastic Limit:		13	
LBW	173.3		Plasticity Index:		19	
TOTAL	203.0		CLASSIFICATION			
			Lean Clay			
			CL			

# Soil Classification Report

## Project Information

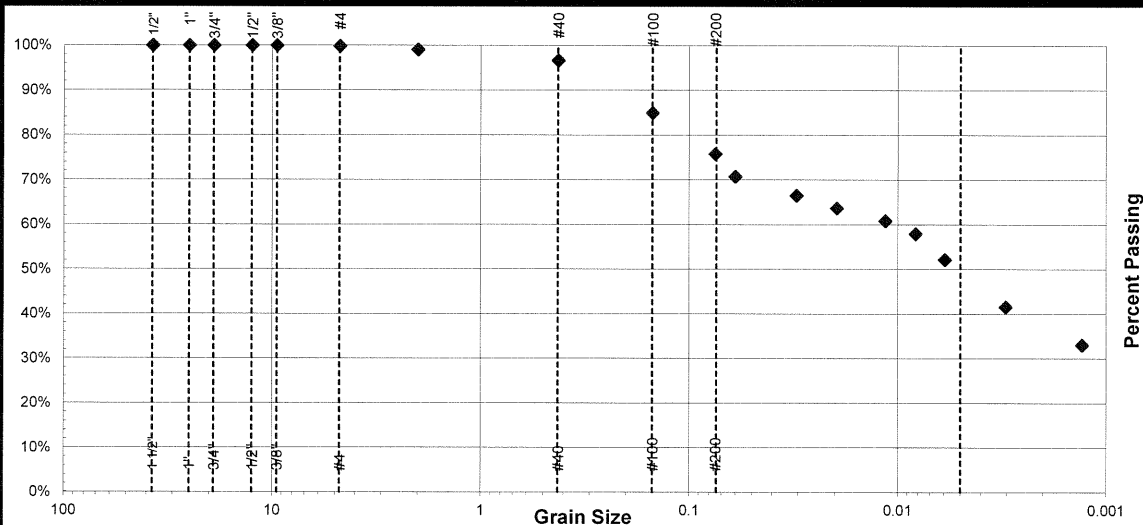
Sample ID: 16-003  
Lab ID: SB-36  
Sampled By: KJV  
Sample Date: 10/6/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Field Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 28-Jan-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	0.1%	0.8%	2.3%	20.9%	75.8%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description					
1 1/2"	0.0	100.0%	Dark Grayish Brown Clay 52'-54' Deep					
1"	0.0	100.0%						
3/4"	0.0	100.0%						
3/8"	0.0	100.0%	Coefficients					
#4	0.3	99.9%	D <sub>60</sub> :	0.0114	Cc:	0.11	Cu:	8.77
#10	1.9	99.0%	D <sub>30</sub> :	0.0013				
#40	5.3	96.7%	D <sub>10</sub> :	0.0013				
#100	26.7	85.0%	Atterberg Limits					
#200	20.9	75.8%	Liquid Limit:		26			
Pan	5.7		Plastic Limit:		11			
LBW	167.1		Plasticity Index:		15			
TOTAL	228.1		CLASSIFICATION					
			Lean Clay with Sand					
			CL					

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# Soil Classification Report

## Project Information

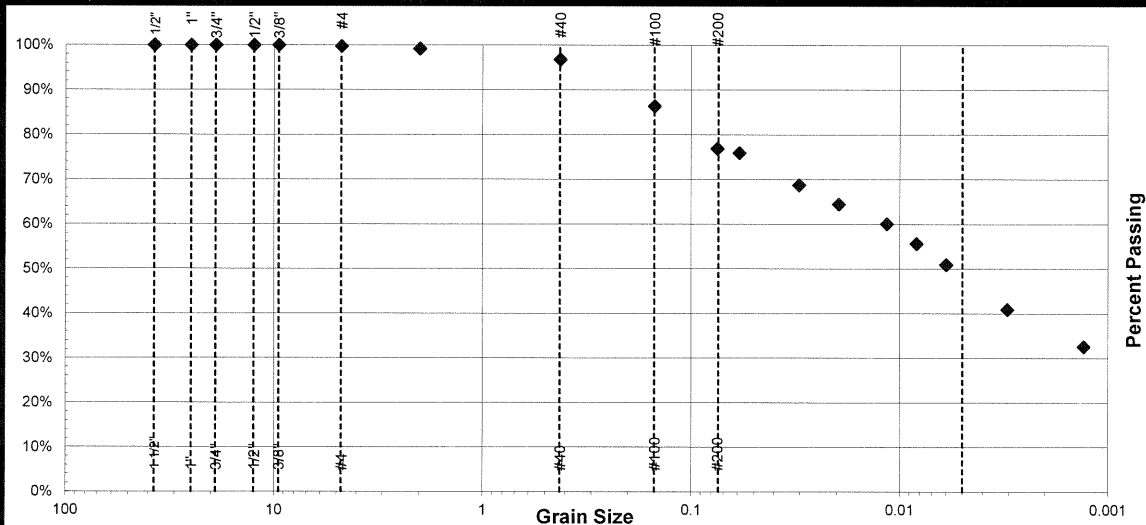
Sample ID: 16-003  
Lab ID: SB-37  
Sampled By: KJV  
Sample Date: 10/7/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 1-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	0.3%	0.6%	2.4%	19.9%	76.9%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Dark Grayish Brown Clay 48'-50' Deep			
1"	0.0	100.0%				
3/4"	0.0	100.0%				
3/8"	0.0	100.0%	Coefficients			
#4	0.5	99.7%	D <sub>60</sub> :	0.0115		
#10	1.1	99.2%	D <sub>30</sub> :	0.0013	Cc:	0.11
#40	4.7	96.8%	D <sub>10</sub> :	0.0013	Cu:	8.85
#100	20.6	86.4%	Atterberg Limits			
#200	18.8	76.9%	Liquid Limit:		25	
Pan	4.7		Plastic Limit:		10	
			Plasticity Index:		15	
LBW	147.7		CLASSIFICATION			
TOTAL	198.1		Lean Clay with Sand			
			CL			

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# Soil Classification Report

## Project Information

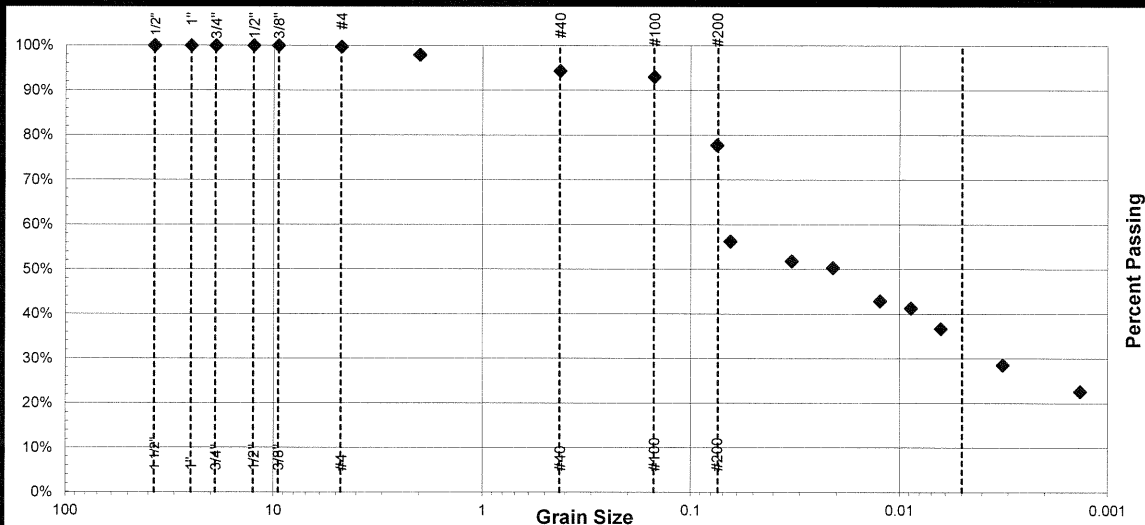
Sample ID: 16-003  
Lab ID: SB-38  
Sampled By: KJV  
Sample Date: 10/5/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 1-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	0.3%	1.8%	3.6%	16.5%	77.8%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description
1 1/2"	0.0	100.0%	
1"	0.0	100.0%	Dark Grayish Brown Clay 60'-62' Deep
3/4"	0.0	100.0%	
3/8"	0.0	100.0%	
#4	0.6	99.7%	Coefficients
#10	3.7	97.9%	
#40	7.4	94.3%	
#100	2.7	93.0%	Atterberg Limits
#200	31.4	77.8%	
Pan	6.2		
LBW	154.1		CLASSIFICATION
TOTAL	206.1		

D <sub>60</sub> :	0.069	Cc:	0.26	Cu:	53.08
D <sub>30</sub> :	0.0048				
D <sub>10</sub> :	0.0013				

Liquid Limit:	20
Plastic Limit:	9
Plasticity Index:	11

CL
----

# Soil Classification Report

## Project Information

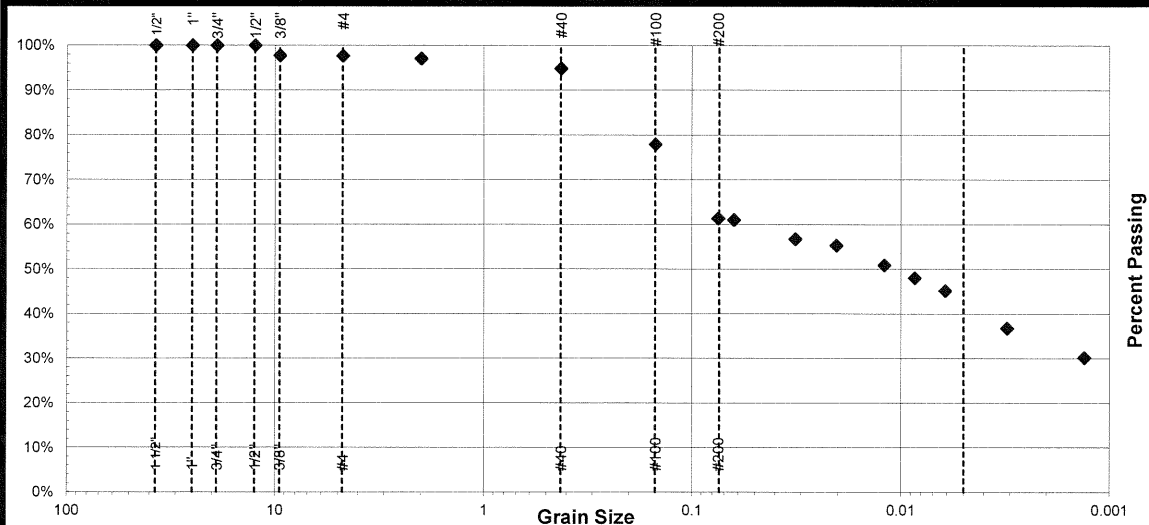
Sample ID: 16-003  
Lab ID: SB-39  
Sampled By: ARM  
Sample Date: 10/7/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 2-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
2.2%	0.1%	0.6%	2.2%	33.5%	61.4%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Dark Grayish Brown Clay 50'-52' Deep			
1"	0.0	100.0%				
3/4"	5.4	97.8%	Coefficients			
3/8"	0.0	97.8%	D <sub>60</sub> :	0.063		
#4	0.2	97.7%	D <sub>30</sub> :	0.00132	Cc:	0.02      Cu:      47.73
#10	1.5	97.1%	D <sub>10</sub> :	0.00132		
#40	5.3	94.9%	Atterberg Limits			
#100	40.8	77.9%	Liquid Limit:		24	
#200	40.0	61.4%	Plastic Limit:		10	
Pan	6.1		Plasticity Index:		14	
LBW	141.8		CLASSIFICATION			
TOTAL	241.1		Sandy Lean Clay			
			CL			

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# Soil Classification Report

## Project Information

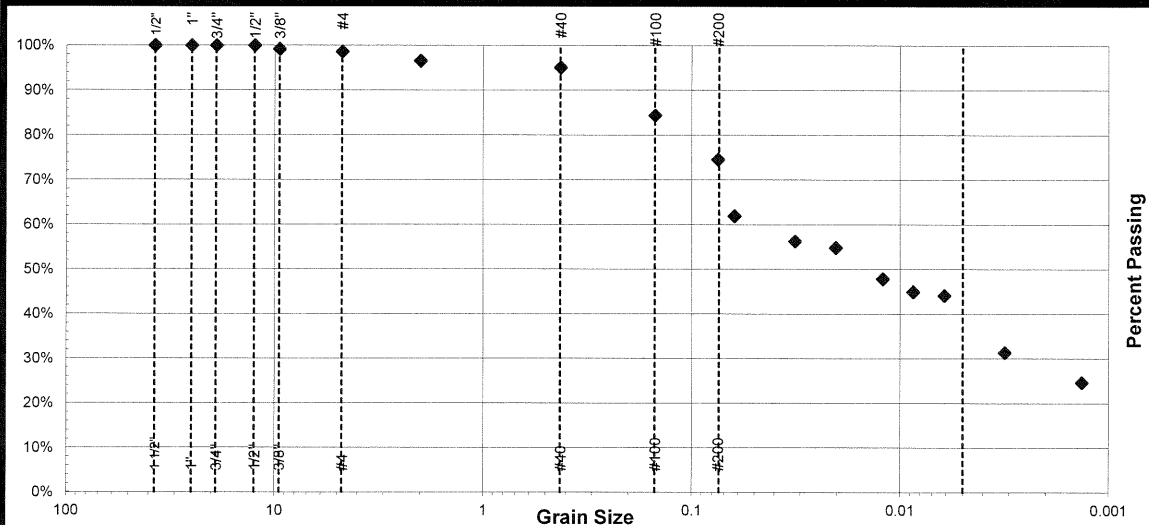
Sample ID: 16-003  
Lab ID: SB-40  
Sampled By: KJV  
Sample Date: 10/12/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Field Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 2-Feb-16

Checked By: KJV  
Check Date: 15-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	1.4%	1.2%	2.3%	20.5%	74.5%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Dark Grayish Brown Clay 48'-50' Deep			
1"	0.0	100.0%				
3/4"	0.0	100.0%				
3/8"	2.3	99.2%	Coefficients			
#4	1.7	98.6%				
#10	3.6	97.4%				
#40	6.6	95.1%	Atterberg Limits			
#100	30.8	84.4%				
#200	28.4	74.5%				
Pan	3.1		CLASSIFICATION			
LBW	212.0					
TOTAL	288.6					
			Lean Clay with Sand			
			CL			

# Soil Classification Report

## Project Information

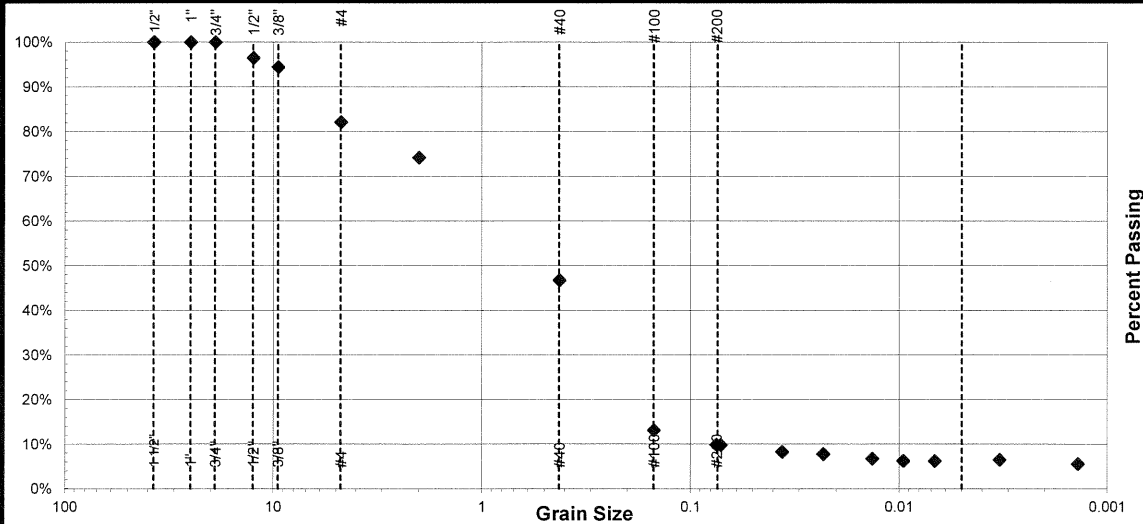
Sample ID: 16-0001  
Lab ID: DB-24  
Sampled By: KJV  
Sample Date: 10/29/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Field Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 20-Jan-16

Checked By: KJV  
Check Date: 16-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
3.3%	14.5%	10.3%	25.1%	36.9%	9.9%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Brown Silty Sand			
1"	0.0	100.0%				
1/2"	7.3	96.7%				
3/8"	5.0	94.4%	Coefficients			
#4	27.2	82.2%	D <sub>60</sub> : 1.21	Cc: 0.93	Cu: 16.13	
#10	22.7	71.9%	D <sub>30</sub> : 0.29			
#40	55.6	46.8%	D <sub>10</sub> : 0.075			
#100	74.4	13.2%	Atterberg Limits			
#200	7.2	9.9%	Liquid Limit:			
Pan	1.6		Plastic Limit:			
LBW	20.4		Plasticity Index:			
TOTAL	221.4		CLASSIFICATION			
			Well Graded Sand With Silt and Gravel			
			<b>SW-SM</b>			

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# Soil Classification Report

## Project Information

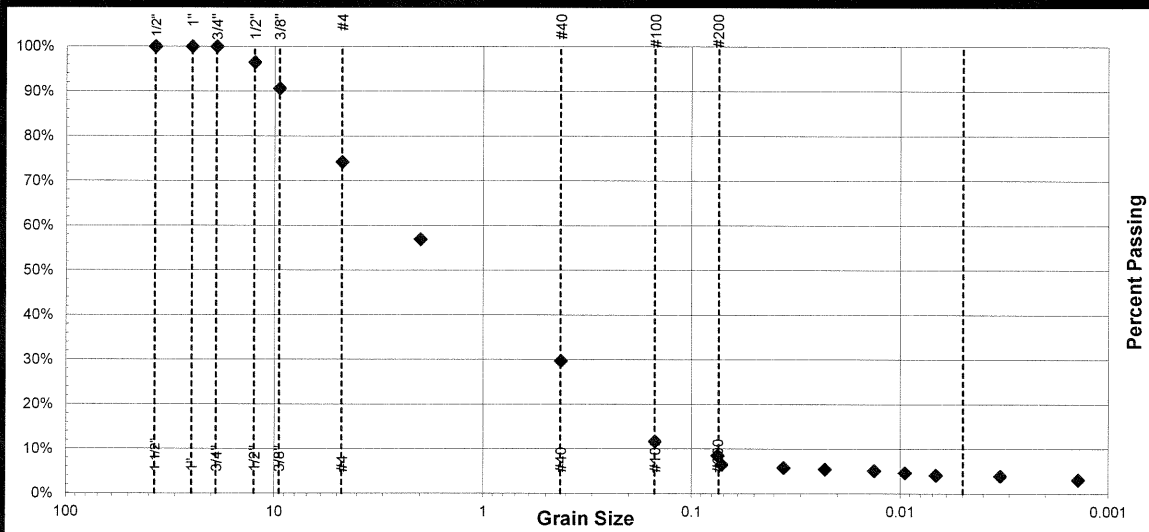
Sample ID: 16-002  
Lab ID: DB-25  
Sampled By: KJV  
Sample Date: 11/4/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Field Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 5-Jan-16

Checked By: KJV  
Check Date: 16-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
3.9%	21.9%	21.8%	22.7%	21.2%	8.6%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description					
1 1/2"	0.0	100.0%	Brown Sand 148'-150', 154-156', 160'-162' Deep					
1"	0.0	100.0%						
1/2"	14.6	96.1%						
3/8"	20.5	90.6%	Coefficients					
#4	61.6	74.2%	D <sub>60</sub> :	2.5	Cc:	0.66	Cu:	22.73
#10	81.8	52.4%	D <sub>30</sub> :	0.425				
#40	85.1	29.8%	D <sub>10</sub> :	0.11				
#100	67.7	11.7%	Atterberg Limits					
#200	11.9	8.6%	Liquid Limit:					
Pan	7.3		Plastic Limit:					
LBW	24.8		Plasticity Index:					
TOTAL	375.3		CLASSIFICATION					
			Well Graded Sand with Silt and Gravel					
			SW-SM					

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# Soil Classification Report

## Project Information

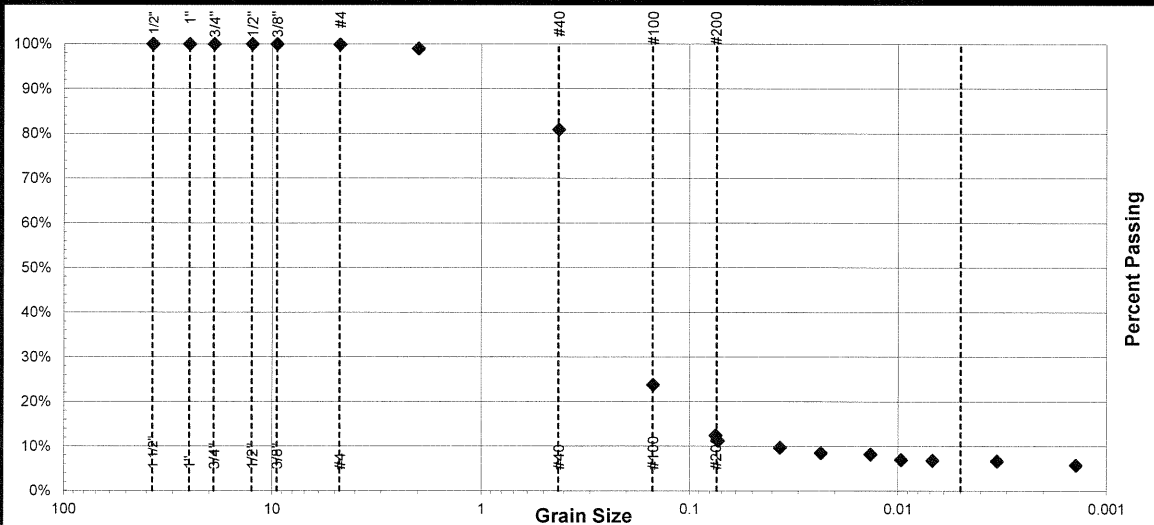
Sample ID: 16-003  
Lab ID: DB-26  
Sampled By: KJV  
Sample Date: 11/13/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 5-Jan-16

Checked By:  
Check Date:

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	0.1%	0.9%	18.1%	68.4%	12.5%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Brown Sand 150'-152', 154'-156', 158'-160', 166'-163' Deep			
1"	0.0	100.0%				
3/4"	0.0	100.0%				
3/8"	0.0	100.0%	Coefficients			
#4	0.3	99.9%				
#10	2.6	99.0%				
#40	52.2	80.9%	Atterberg Limits			
#100	165.1	23.8%				
#200	32.7	12.5%				
Pan	9.6		CLASSIFICATION			
LBW	26.5					
TOTAL	289.1					
			Well Graded Sand with Silt			
			SW-SM			

# Soil Classification Report

## Project Information

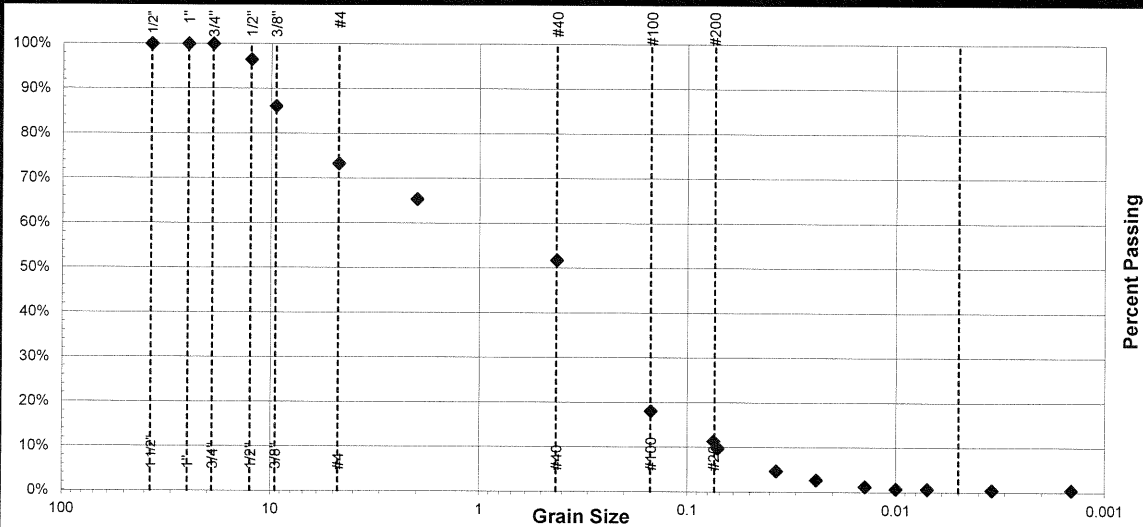
Sample ID: SB-27  
Lab ID: 16-004  
Sampled By: KJV  
Sample Date: 10/27/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 27-Jul-07

Checked By: KJV  
Check Date: 16-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
7.9%	18.7%	9.4%	12.2%	40.4%	11.4%

Sieve Size	Weight Retained (grams)	Percent Passing	<b>Sample Description</b>  Brown Sand 80'-84', 86'-87' Deep  <b>Coefficients</b>  D <sub>60</sub> : 1.69 D <sub>30</sub> : 0.17    Cc: 0.23    Cu: 23.15 D <sub>10</sub> : 0.073  <b>Atterberg Limits</b>  Liquid Limit: Plastic Limit: Plasticity Index:  <b>CLASSIFICATION</b>  Well Graded Sand With Silt and Gravel  <b>SW-SM</b>
1 1/2"	0.0	100.0%	
1"	0.0	100.0%	
1/2"	24.7	92.1%	
3/8"	18.5	86.1%	
#4	39.7	73.3%	
#10	29.1	64.0%	
#40	37.8	51.8%	
#100	104.7	18.1%	
#200	20.9	11.4%	
Pan	5.3		
LBW	30.0		
TOTAL	310.8		

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# Soil Classification Report

## Project Information

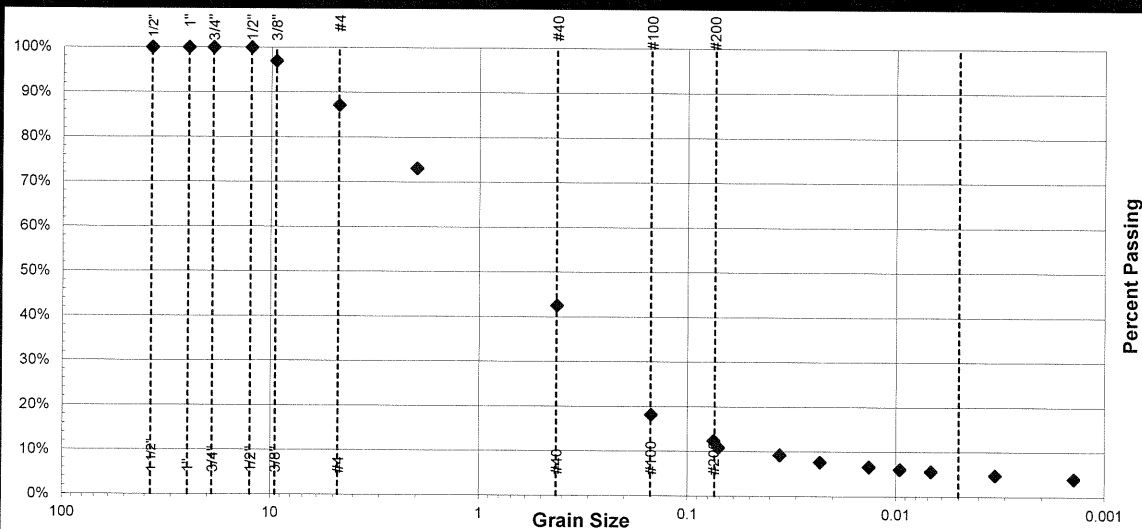
Sample ID: 16-005  
Lab ID: DB-28  
Sampled By: KJV  
Sample Date: 10/15/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 6-Jan-16

Checked By: KJV  
Check Date: 16-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	12.8%	18.3%	26.3%	30.2%	12.4%

Sieve Size	Weight Retained (grams)	Percent Passing	<b>Sample Description</b>  Brown Sand 143'-149' Deep  <b>Coefficients</b> D <sub>60</sub> : 1.82 D <sub>30</sub> : 0.28    Cc: 0.81    Cu: 34.34 D <sub>10</sub> : 0.053  <b>Atterberg Limits</b> Liquid Limit: Plastic Limit: Plasticity Index:  <b>CLASSIFICATION</b> Well Graded Sand With Silt  <b>SW-SM</b>
1 1/2"	0.0	100.0%	
1"	0.0	100.0%	
1/2"	0.0	100.0%	
3/8"	7.3	97.0%	
#4	23.8	87.2%	
#10	44.3	68.9%	
#40	63.7	42.6%	
#100	59.0	18.2%	
#200	14.1	12.4%	
Pan	7.3		
LBW	22.7		
TOTAL	242.3		



# Soil Classification Report

## Project Information

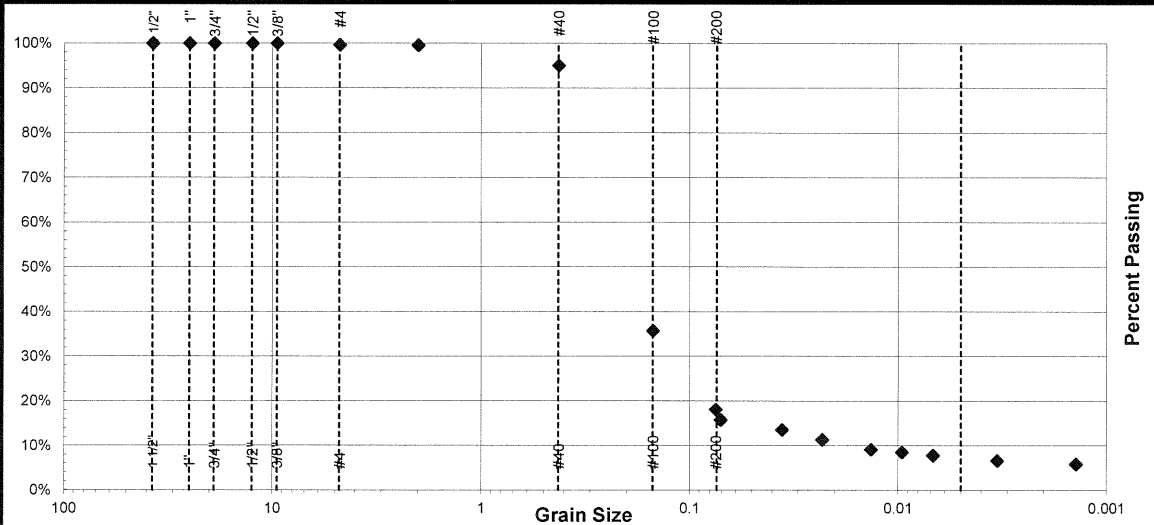
Sample ID: 16-006  
Lab ID: SB-38  
Sampled By: KJV  
Sample Date: 10/5/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 14-Jan-16

Checked By: KJV  
Check Date: 16-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	0.3%	0.1%	4.5%	76.9%	18.1%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description			
1 1/2"	0.0	100.0%	Brown Sand 104'-106', 109'-111' Deep			
1"	0.0	100.0%				
1/2"	0.0	100.0%				
3/8"	0.0	100.0%	Coefficients			
#4	0.8	99.7%	D <sub>60</sub> : 0.28	Cc: 2.40	Cu: 15.56	
#10	0.2	99.6%	D <sub>30</sub> : 0.11			
#40	10.7	95.0%	D <sub>10</sub> : 0.018			
#100	139.9	35.7%	Atterberg Limits			
#200	41.6	18.1%	Liquid Limit:			
Pan	17.1		Plastic Limit:			
LBW	25.6		Plasticity Index:			
TOTAL	235.9		CLASSIFICATION			
			Clayey Sand			
			SC			

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# Soil Classification Report

## Project Information

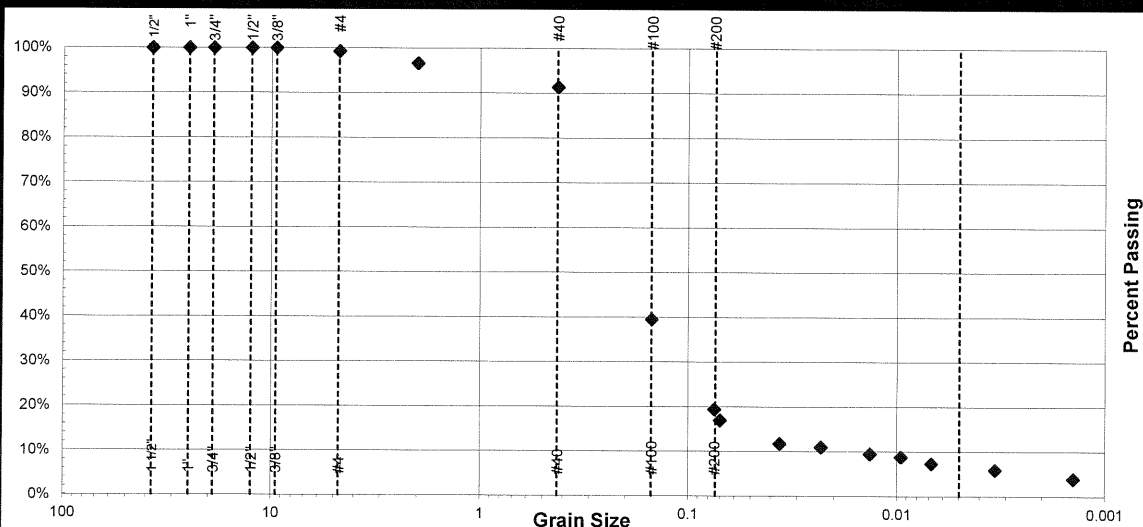
Sample ID: 16-007  
Lab ID: SB-43  
Sampled By: ARM  
Sample Date: 12/15/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 14-Jan-16

Checked By: KJV  
Check Date: 16-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	0.7%	2.7%	5.2%	71.9%	19.4%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description
1 1/2"	0.0	100.0%	
1"	0.0	100.0%	Brown Sand 111.2'-112.4', 114.1'-114.6', 115'-115.5', 116'-117'
1/2"	0.0	100.0%	
3/8"	0.0	100.0%	Coefficients
#4	1.8	99.3%	
#10	6.5	96.6%	D <sub>60</sub> : 1.21
#40	12.8	91.4%	D <sub>30</sub> : 0.11 Cc: 0.56 Cu: 67.22
#100	126.4	39.5%	D <sub>10</sub> : 0.018
#200	49.0	19.4%	Atterberg Limits
Pan	17.7		
LBW	29.7		CLASSIFICATION
TOTAL	243.9		
			Clayey Sand
			<b>SC</b>

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# Soil Classification Report

## Project Information

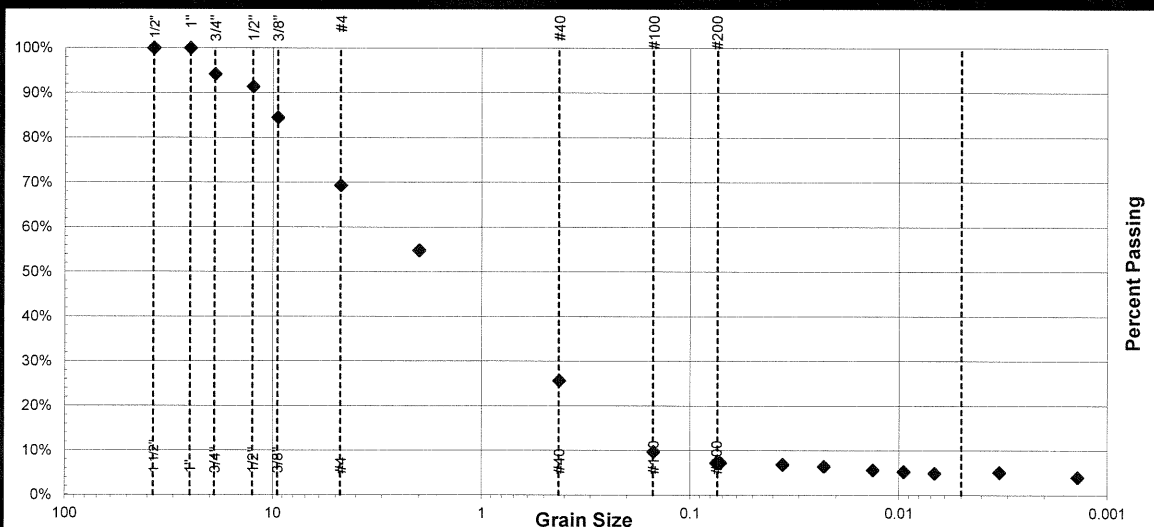
Sample ID: 16-008  
Lab ID: SB-41  
Sampled By: ARM  
Sample Date: 11/23/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 13-Jan-16

Checked By: KJV  
Check Date: 16-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
9.5%	21.2%	19.9%	23.8%	18.4%	7.2%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description					
1 1/2"	0.0	100.0%	Brown Sand 66'-68', 70'-72', 78'-80' Deep					
3/4"	18.4	93.6%						
1/2"	8.9	90.5%						
3/8"	17.4	84.5%	Coefficients					
#4	43.6	69.4%	D <sub>60</sub> :	3.38	Cc:	9.63	Cu:	22.53
#10	57.3	49.5%	D <sub>30</sub> :	2.21				
#40	68.6	25.7%	D <sub>10</sub> :	0.15				
#100	45.8	9.8%	Atterberg Limits					
#200	7.3	7.2%	Liquid Limit:					
Pan	4.5		Plastic Limit:					
LBW	16.4		Plasticity Index:					
TOTAL	288.2		CLASSIFICATION					
			Well Graded Sand with Silt and Gravel					
			SW-SM					

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# Soil Classification Report

## Project Information

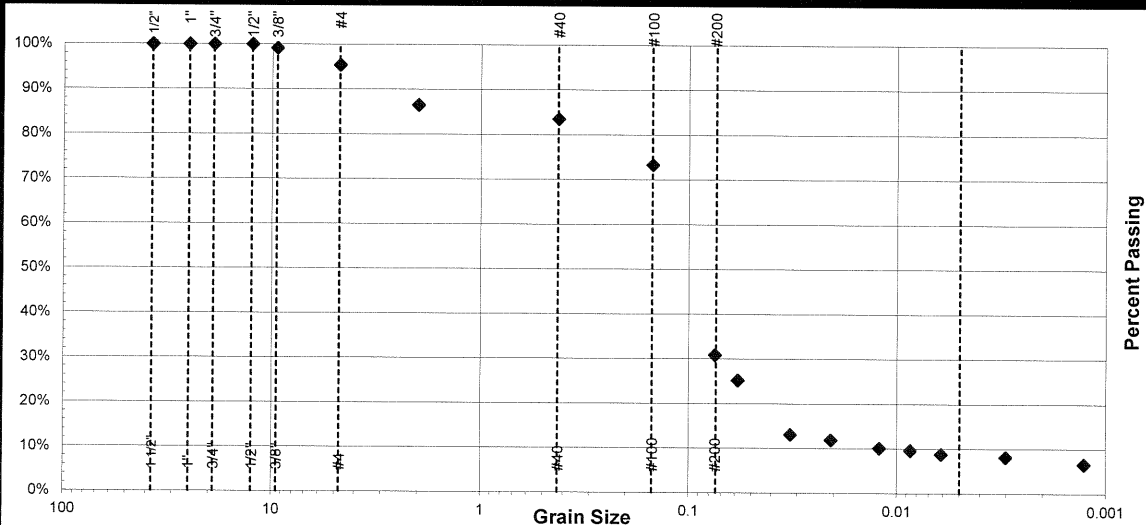
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Lab ID: SB-42  
Sampled By: ARM  
Sample Date: 12/14/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 27-Jul-07

Checked By: KJV  
Check Date: 16-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	4.6%	9.1%	2.8%	52.6%	30.9%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description
1 1/2"	0.0	100.0%	
1"	0.0	100.0%	Brown Sand 77'-78', 80'-84' Deep
3/4"	0.0	100.0%	
3/8"	2.4	99.1%	Coefficients
#4	10.6	95.4%	
#10	25.6	86.3%	Atterberg Limits
#40	7.9	83.5%	
#100	28.7	73.3%	CLASSIFICATION
#200	119.7	30.9%	
Pan	45.7		SC
LBW	41.4		
TOTAL	282.0		

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# Soil Classification Report

## Project Information

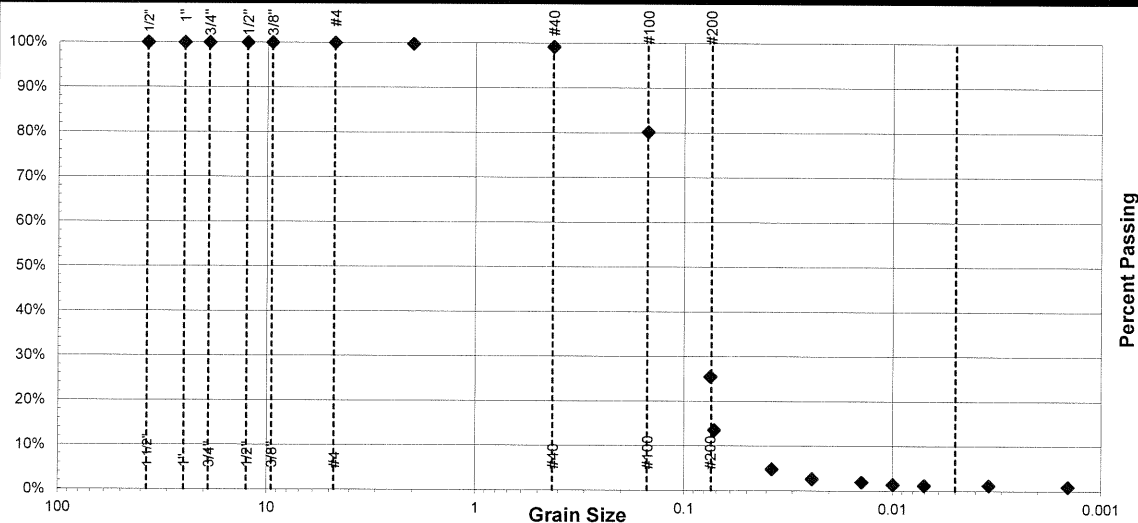
Sample ID: 10-010  
Lab ID: SB-44  
Sampled By: KJV  
Sample Date: 12/18/2015

Client: Ottawa County Farms Landfill  
Project: Hydrogeological Feild Investigation  
Project No.: 001.01-15-002

Tested By: ARM  
Date: 18-Jan-16

Checked By: KJV  
Check Date: 16-Mar-16

## Grain Size Analysis



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	
0.0%	0.0%	0.2%	0.6%	73.7%	25.5%

Sieve Size	Weight Retained (grams)	Percent Passing	Sample Description
1 1/2"	0.0	100.0%	
1"	0.0	100.0%	Brown Sand 113'-116' Deep
1/2"	0.0	100.0%	
3/8"	0.0	100.0%	Coefficients
#4	0.1	100.0%	
#10	0.5	99.7%	D <sub>60</sub> : 0.38
#40	1.3	99.2%	D <sub>30</sub> : 0.086    Cc: 0.22    Cu: 4.37
#100	44.5	80.2%	D <sub>10</sub> : 0.087
#200	128.1	25.5%	Atterberg Limits
Pan	42.1		
LBW	17.7		CLASSIFICATION
TOTAL	234.3		

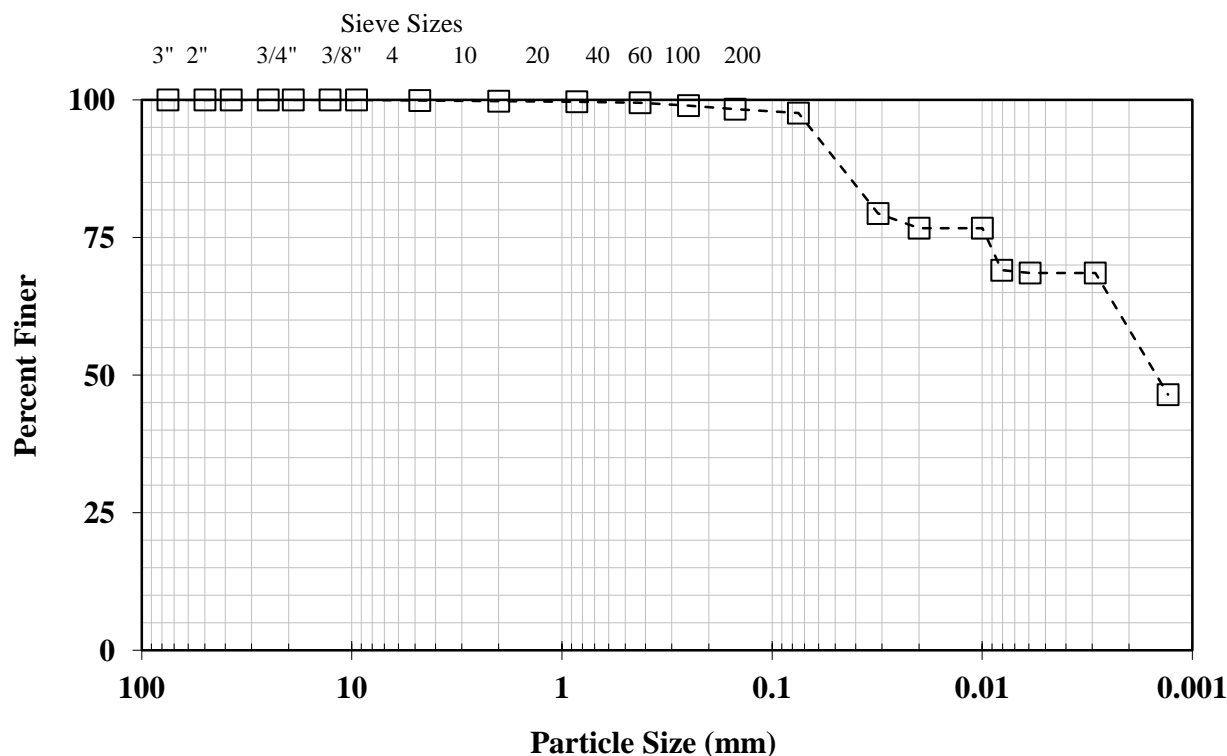
Clayey Sand		
<b>SC</b>		

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## Particle Size Analysis for Soils

Client: Weaver Consultants Group  
 Project: Ottawa County Farms Expansion  
 Sample: DB-24 (22-24)

TRI Log#: 19733.1  
 Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	99.9
No. 10 (2.00 mm)	99.8
No. 20 (0.841 mm)	99.7
No. 40 (0.420 mm)	99.5
No. 60 (0.250 mm)	99.0
No. 100 (0.149 mm)	98.3
No. 200 (0.074 mm)	97.6
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	68.6
0.002 mm	58.3

USCS Classification (ASTM D2487)	Silt (ML)	
<b>As-Received Moisture Content (%)</b>	(ASTM D2216)	--
<b>Atterberg Limits</b> (ASTM D4318, Method A : Multipoint)	Liquid Limit (3 pt)	43
	Plastic Limit	31
	Plastic Index	12
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
<b>Specific Gravity</b>	(ASTM D854)	2.61
<b>Organic Content (%)</b>	(ASTM D2974)	--
<b>Carbonate Content (%)</b>	(ASTM D4373)	--

Jeffrey A. Kuhn, Ph.D., P.E., 4/8/2016

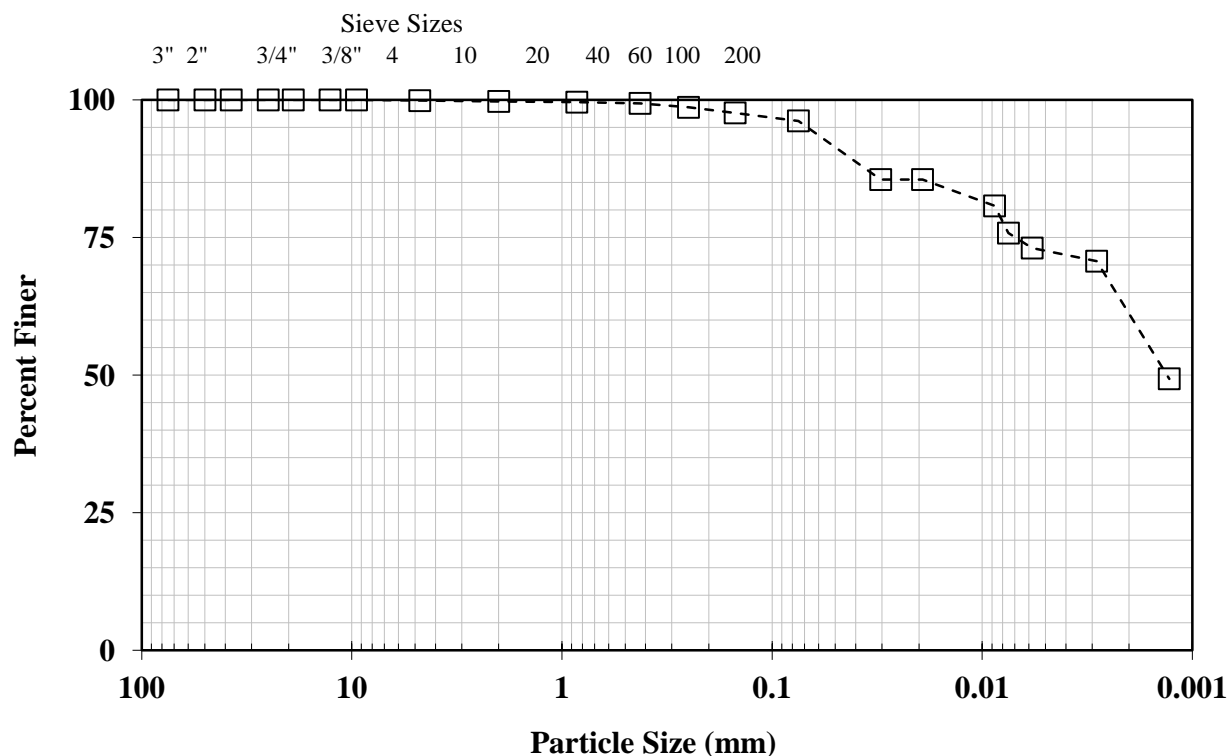
Quality Review/Date

Tested by: KH & PC

## Particle Size Analysis for Soils

Client: Weaver Consultants Group  
 Project: Ottawa County Farms Expansion  
 Sample: DB-27 (20-22 & 22-24)

TRI Log#: 19733.2  
 Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	99.9
No. 10 (2.00 mm)	99.7
No. 20 (0.841 mm)	99.6
No. 40 (0.420 mm)	99.4
No. 60 (0.250 mm)	98.7
No. 100 (0.149 mm)	97.6
No. 200 (0.074 mm)	96.2
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	72.6
0.002 mm	61.1

USCS Classification (ASTM D2487)	Lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	--
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit (3 pt)	48
	Plastic Limit	23
	Plastic Index	25
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	2.69
Organic Content (%)	(ASTM D2974)	--
Carbonate Content (%)	(ASTM D4373)	--

Jeffrey A. Kuhn, Ph.D., P.E., 4/8/2016

Quality Review/Date

Tested by: KH & PC



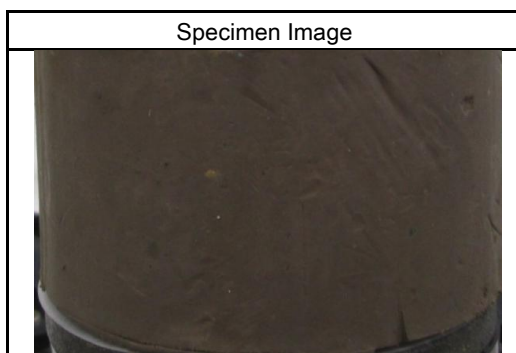
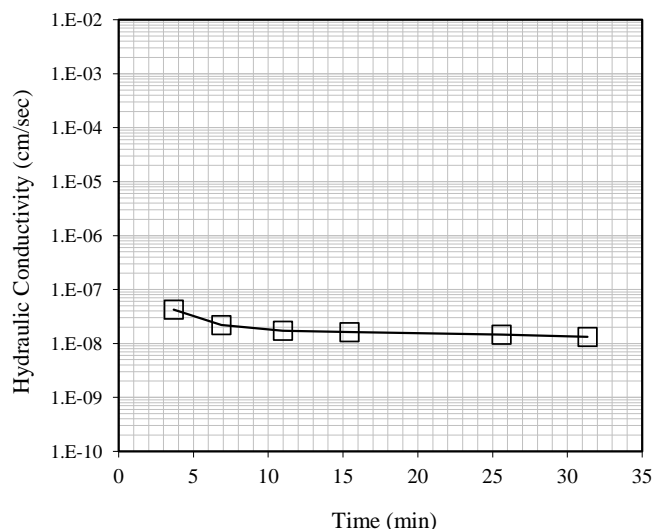




## Hydraulic Conductivity

Client: Weaver Consultants Group  
Project: Ottawa County Farms Expansion  
Sample ID: DB-24 (22-24)

TRI Log #: 19733  
Test Method: ASTM D5084  
Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.83
Height (in)	1.70
Initial Mass (g)	363.2
Sample Area (in <sup>2</sup> )	6.29
Water Content (%)	23.2
Total Unit Weight (pcf)	129.0
Dry Unit Weight (pcf)	104.7
Specific Gravity (ASTM D854)	2.61
Degree of Saturation	109.0
Void Ratio	0.56
Porosity	0.36
1 Pore Volume (cc)	62.7
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.98

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
11.0	1.7E-08
15.4	1.6E-08
25.6	1.5E-08
31.4	1.3E-08
Average, Last 2 Readings	1.4E-08

Note: Permeation measurements were made with a mercury U-tube.

Jeffrey A. Kuhn, Ph.D., P.E., 3/10/2016

Analysis & Quality Review/Date

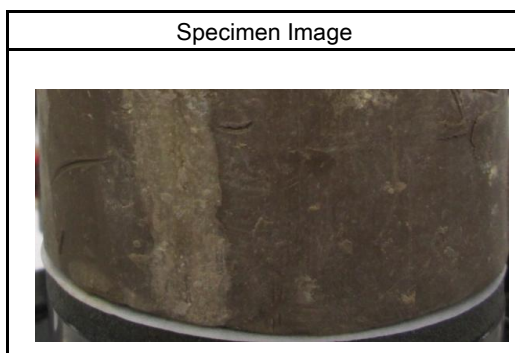
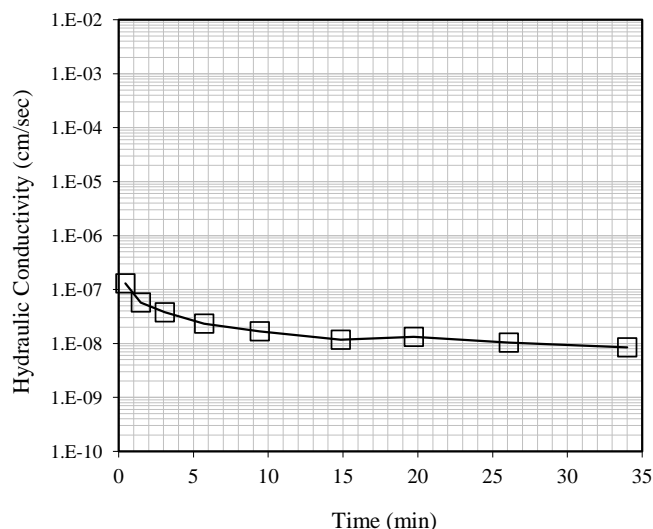
Testing Performed By: SOC & LC



## Hydraulic Conductivity

Client: Weaver Consultants Group  
Project: Ottawa County Farms Expansion  
Sample ID: DB-27: (20-22 & 22-24)

TRI Log #: 19733  
Test Method: ASTM D5084  
Method F



Note: Permeation measurements were made with a mercury U-tube.

Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.81
Height (in)	1.46
Initial Mass (g)	317.5
Sample Area (in <sup>2</sup> )	6.21
Water Content (%)	15.7
Total Unit Weight (pcf)	133.3
Dry Unit Weight (pcf)	115.2
Specific Gravity (ASTM D854)	2.69
Degree of Saturation	92.6
Void Ratio	0.46
Porosity	0.31
1 Pore Volume (cc)	46.6
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.98

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
14.9	1.2E-08
19.7	1.3E-08
26.1	1.0E-08
34.0	8.5E-09
Average, Last 2 Readings	9.4E-09

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Analysis & Quality Review/Date

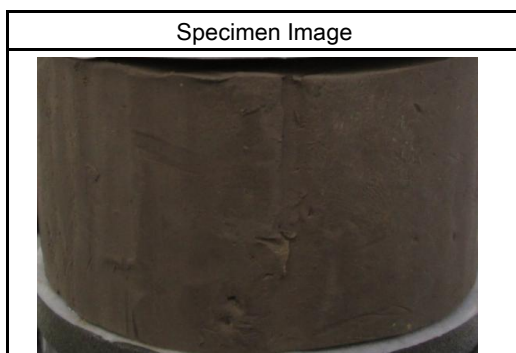
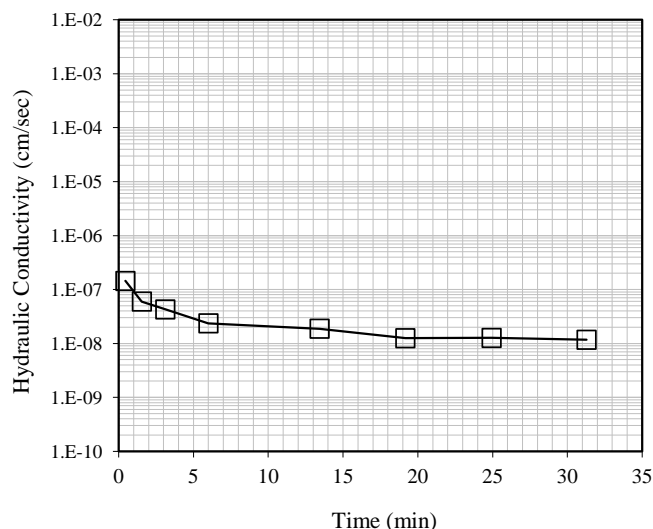
Testing Performed By: SOC & LC



## Hydraulic Conductivity

Client: Weaver Consultants Group  
Project: Ottawa County Farms Expansion  
Sample ID: DB-27: (42-44)

TRI Log #: 19733  
Test Method: ASTM D5084  
Method F



Note: Permeation measurements were made with a mercury U-tube.

Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.75
Height (in)	1.55
Initial Mass (g)	303.4
Sample Area (in <sup>2</sup> )	5.94
Water Content (%)	23.0
Total Unit Weight (pcf)	125.8
Dry Unit Weight (pcf)	102.2
Specific Gravity (ASTM D854)	2.60
Degree of Saturation	101.9
Void Ratio	0.59
Porosity	0.37
1 Pore Volume (cc)	55.7
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.98

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
13.4	1.9E-08
19.2	1.2E-08
24.9	1.3E-08
31.3	1.2E-08
Average, Last 2 Readings	1.2E-08

Jeffrey A. Kuhn, Ph.D., P.E., 3/10/2016

Analysis & Quality Review/Date

Testing Performed By: SOC & LC

## *1995 Soil Testing Data*

## **APPENDIX E**

### **• SOIL TESTING DATA •**

## **SOIL TESTING DATA**

A total of 20 soil samples were submitted for physical soil testing at Dell's soil testing laboratory. Grain size distribution by sieve and hydrometer tests were conducted in accordance with ASTM Method D422. Tests for Atterburg Limits (ASTM D4318) and subsequent soil classifications (ASTM D2487) were performed. Hydraulic conductivity tests were performed on five of the samples in accordance with ASTM D5084 (as modified by Part 115).

# ATTERBERG LIMITS DETERMINATION (ASTM D4318-84)

Project Name: LAIDLAW WASTE SYSTEMS  
 Project Number: 940387  
 Task Number: 0004  
 Location of Test: Dell Engineering, Inc.  
 Personnel: JAG

Sample Boring: DB-1  
 Depth of Sample: 28-30'  
 Sample Source: SHELBY TUBE  
 Date Collected: 7/5/94  
 Date Analyzed: 7/25/94

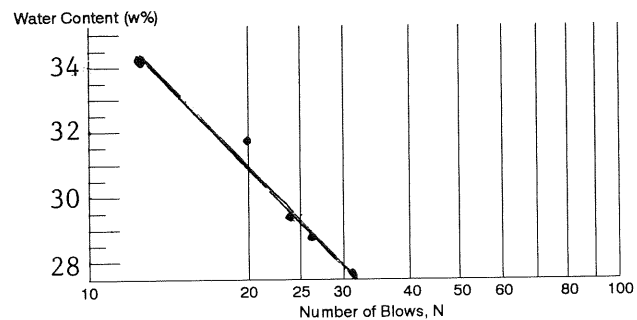
Soil Classification: CL-SANDY LEAN CLAY

## Liquid Limits Determination

Can Number:	3	4	6	11	14
Weight of Wet Soil + Can:	33.90	28.30	28.10	29.30	26.10
Weight of Dry Soil + Can:	29.60	24.50	24.30	25.60	23.00
Weight Of Can:	14.00	11.20	11.30	13.90	13.90
Weight of Dry Soil:	15.60	13.30	13.00	11.70	9.10
Weight of Moisture:	4.30	3.80	3.80	3.70	3.10
Water Content, (w%):	27.56	28.57	29.23	31.62	34.07
Number of Blows, (N):	32	27	24	20	14

## Plastic Limits Determination

Can Number:	1	2	7	12
Weight of Wet Soil + Can:	27.90	28.00	24.80	22.80
Weight of Dry Soil + Can:	26.10	25.90	23.30	21.30
Weight of Can:	14.30	12.00	14.00	11.50
Weight of Dry Soil:	11.80	13.90	9.30	9.80
Weight of Moisture:	1.80	2.10	1.50	1.50
Water Content, (w%=wp):	15.25	15.11	16.13	15.31
Average Water Content =	15.4%			



Liquid Limit = 29.5%  
 Plastic Limit = 15.4%  
 Plasticity Index = 14.1%

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring	DB-1
Project Number:	940387	Depth of Sample:	28-30' BGS
Task Number:	0004	Sample Source:	SHELBY TUBE
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	7/25/94
Personnel:	JAG		

Soil Classification                      CL-SANDY LEAN CLAY

LOSS BY WASHING

Pan Weight (grams) =	482.2	Weight of Soil Before Washing (grams) =	400.00
Pan and Dry Soil Weight (grams):	882.2	Weight of Soil After Washing (grams) =	124.20
		Difference (grams) =	275.80
		Percent Lost by Washing =	68.95

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	%Passing
#3/4	0.0	0.0	0.0	100.0
#4	6.80	1.70	1.70	98.30
#10	10.00	2.50	4.20	95.80
#40	13.20	3.30	7.50	92.50
#100	52.80	13.20	20.70	79.30
#200	40.80	10.20	30.90	69.10
PAN	0.40	69.05	99.95	0.00
TOTAL	124.00	99.95	—	—

% Gravel =	1.70
% Coarse Sand =	2.50
% Medium Sand =	3.30
% Fine Sand =	23.40
% Silt or Clay =	69.05

NOTES

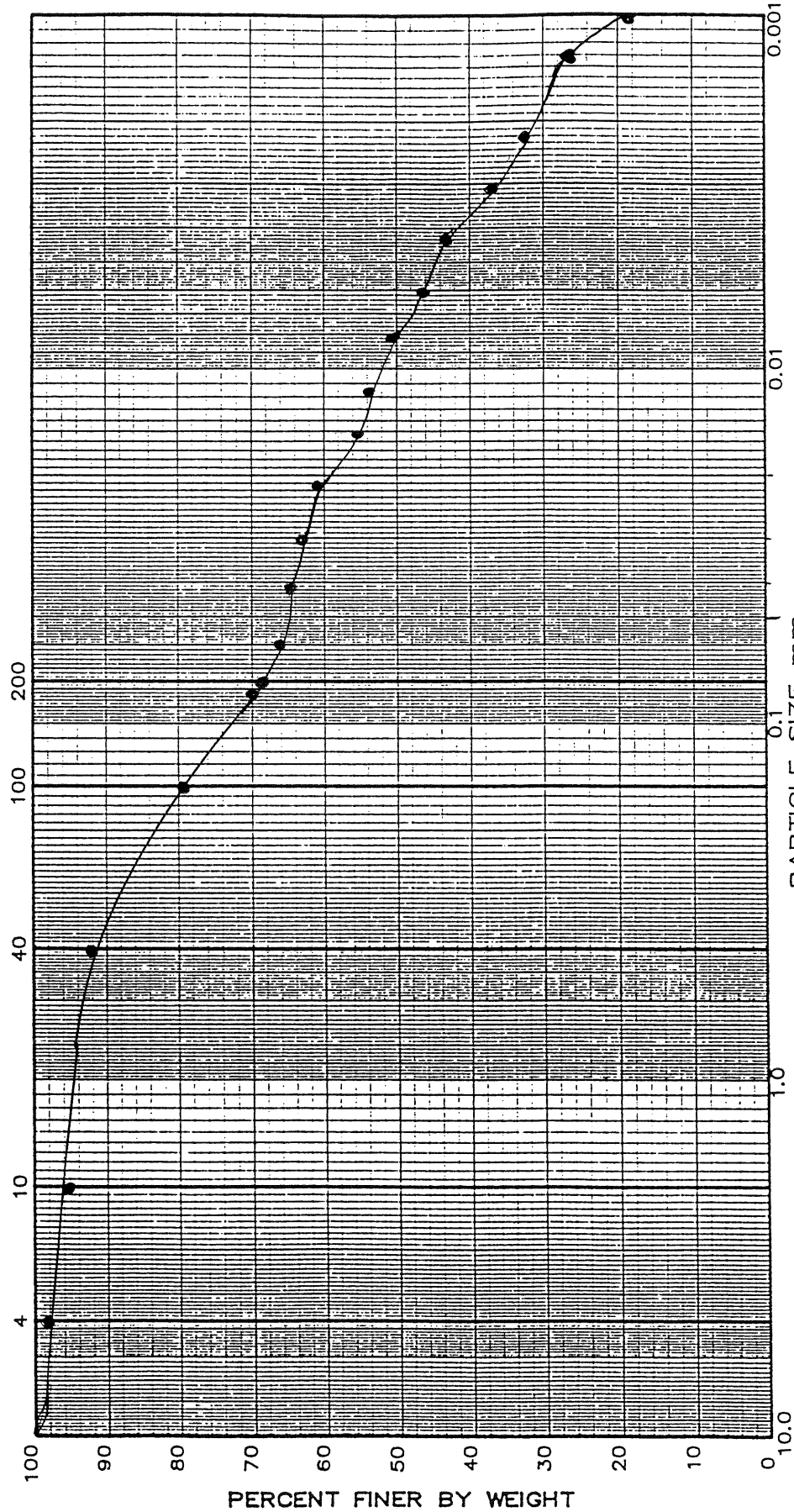
% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.



JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL		COARSE SAND		MEDIUM SAND		FINE SAND		SILT OR CLAY	
1.70		2.50		3.30		23.40		69.05	
BORING NO.		SAMPLE NO.		DEPTH		ASTM CLASSIFICATION		SOIL DESCRIPTION	
DB-1		--		28-30'		CL-SANDY LEAN CLAY		CLAY WITH SAND	

# HYDROMETER (ASTM D-422)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-1
Project Number:	940387	Depth of Sample:	28-30'
Task Number:	0004	Sample Source:	Shelby Tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/5/94
Personnel:	JAG	Date Analyzed:	7/26/94

Soil Classification: CL-SANDY LEAN CLAY

## -- SAMPLE INFORMATION --

Sample Weight (gm) =	50.0	Specific Gravity (Gs) =	2.67
Total Percent Fines =	69.05%	Test Sample Fraction Used -	Passing # 40 Sieve

Date	Time	Elapsed Time (min)	Temp (C)	Hydrometer Reading (Ra)	Temp Correction (Ct)	Corrected Reading (Rc)	% Finer	Corrected % Finer	Meniscus Correction (R)	L	L/t	Diameter (mm)
7/26/94	10:00	0.25	20	45	0.0	39	77.7	70.2	46	8.915	35.66	0.0824
		0.5	20	43	0.0	37	73.7	66.6	44	9.243	18.49	0.0593
	10:01	1	20	42	0.0	36	71.7	64.8	43	9.407	9.41	0.0423
	10:02	2	20	41	0.0	35	69.7	63.0	42	9.571	4.79	0.0302
	10:04	4	20	40	0.0	34	67.7	61.2	41	9.735	2.43	0.0215
	10:08	8	20	37	0.0	31	61.8	55.8	38	10.23	1.28	0.0156
	10:15	15	20	36	0.0	30	59.8	54.0	37	10.39	0.69	0.0115
	10:30	30	20	34	0.0	28	55.8	50.4	35	10.72	0.36	0.0082
	11:00	60	20	32	0.0	26	51.8	46.8	33	11.05	0.18	0.0059
	12:00	120	20	30	0.0	24	47.8	43.2	31	11.38	0.09	0.0042
	14:00	240	20	27	0.0	21	41.8	37.8	28	11.87	0.05	0.0031
	18:00	480	20	24	0.0	18	35.9	32.4	25	12.36	0.03	0.0022
7/27/94	10:00	1440	20	21	0.0	15	29.9	27.0	22	12.85	0.01	0.0013
7/28/94	10:00	2880	20	16	0.0	10	19.9	18.0	17	14.00	0.00	0.0010

Correction for Gs = 1.00

Zero Correction = 6

Unit Weight of Soil Solids and Temperature Combination Constant (K) = 0.01380

Percent Finer Correction:

Interpolate Hydrometer Data to determine % Finer at 0.075mm (#200 sieve)

% Finer (From Hydrometer Analysis) at 0.075mm = 76.41%

Establish Correction Factor to Correlate % Passing #200 Sieve to Finer % in Hydrometer Analysis

% Finer Correction = 0.9037

## NOTES:

Although the sample included all particles which passed the #40 sieve, the Corrected % Finer was computed to reflect all particles which passed the #200 sieve during the sieve analysis.

HYDRAULIC CONDUCTIVITY  
(FLEXIBLE-WALL PERMEAMETER)  
(ASTM D-5084)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Location:	DB-1
Project Number:	940387	Depth of Sample:	28-30' BGS
Task Number:	0004	Sample Source:	Shelby Tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/5/94
Personnel:	JAG	Report Date:	8/19/94

Soil Classification: CL-SANDY LEAN CLAY

--SAMPLE INFORMATION--

Soil Type:	CLAY	Permeameter #:	6
Height (cm):	4.8	Permeant:	.01 N CASO4
Diameter (cm):	7.2	Upper Burette Area:	2.075
Area (cm <sup>2</sup> ):	40.7	Upper Burette Pressure (psi):	25.0
Volume (cm <sup>3</sup> ):	195.4	Lower Burette Area (cm <sup>2</sup> ):	2.083
Initial Weight (grams):	454.3	Lower Burette Pressure (psi):	27.0
Initial Moisture Content:	16.60%	Chamber Pressure (psi):	30.0
Final Weight (grams):	454.10	Pressure Gradient:	29.3
Final Moisture Content:	16.50%	alpha:	0.123
Specific Gravity:	2.67		

Elapsed Time (min)	V (ml) up	V (ml) low	Head (cm)	Dt (min)	Dt (sec)	Ln (Ht/Ht)	Permeability (K at T)	Temp C	Permeability (K at T=20)
0	49.6	8.0	160.8	0	0	—	—	21.0	—
2820	46.6	12.8	157.1	2820	169200	2.4E-02	1.71E-08	21.0	1.67E-08
3360	45.8	13.8	156.2	540	32400	5.5E-03	2.09E-08	21.0	2.04E-08
4260	44.4	15.2	154.9	900	54000	8.7E-03	1.97E-08	21.0	1.92E-08
4620	44.0	15.4	154.6	360	21600	1.9E-03	1.06E-08	21.0	1.04E-08
4740	43.8	15.6	154.4	120	7200	1.2E-03	2.12E-08	21.0	2.07E-08
8580	38.0	21.2	148.9	3840	230400	3.6E-02	1.93E-08	21.0	1.88E-08
9120	37.2	22.0	148.1	540	32400	5.2E-03	1.96E-08	21.0	1.92E-08
10020	36.0	23.2	147.0	900	54000	7.8E-03	1.78E-08	21.0	1.74E-08
10320	35.6	23.8	146.5	300	18000	3.3E-03	2.24E-08	21.0	2.18E-08
12900	32.0	27.4	143.0	2580	154800	2.4E-02	1.90E-08	21.0	1.85E-08
14580	29.6	29.8	140.7	1680	100800	1.6E-02	1.98E-08	21.0	1.93E-08
18380	24.0	35.4	135.3	3800	228000	3.9E-02	2.10E-08	21.0	2.05E-08
21540	20.4	39.2	131.8	3160	189600	2.7E-02	1.73E-08	21.0	1.68E-08
24420	16.8	43.0	128.2	14100	846000	1.3E-01	1.93E-08	21.0	1.89E-08

Average Stabilized Permeability, K(cm/sec) = 1.85E-08

Notes:

1. N.A. = Not available
2. — = Averaging ended

# **SPECIFIC GRAVITY** **(ASTM D-854)**

Project Name: LAILAW WASTE SYSTEMS

Project Number: 940387 Task Number: 0004 Activity Number: -----

Date: 7/25/94 Personnel: JAG

Location of Test: DELL ENGINEERING, INC. Sample Source: SHELBY TUBE Sample Boring: DB-1

Soil Classification: CL - SANDY LEAN CLAY Depth of Sample: 28 - 30' BGS

TEST NUMBER:	1	2		
Volumetric Flask Number	2	2		
Volume of Flask	500.0	500.0		
Weight of Flask + Water Filled to Mark, W <sub>1</sub> (g)	677.6	677.6		
Weight of Flask + Soil + Water Filled to Mark, W <sub>2</sub> (g)	709.0	708.7		
Weight of Dry Soil, W <sub>3</sub> (g)	50.0	50.0		
Temperature of Test, T <sub>1</sub> °C	20.0	20.0		
$G_s \text{ (at } T_1 \text{ °C)} = \frac{W_3}{(W_1 + W_3) - W_2}$	2.69	2.65		
Temperature Correction Factor, K	1.0	1.0		
$G_s \text{ (at } 20 \text{ °C)} = K \times G_s \text{ (at } T \text{ °C)}$	2.69	2.65		

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring	DB-1
Project Number:	940387	Depth of Sample:	159-161' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	7/29/94
Personnel:	JAG		

Soil Description                      CLAYEY SAND WITH GRAVEL

LOSS BY WASHING

Pan Weight (grams) =	1010.0	Weight of Soil Before Washing (grams) =	262.10
Pan and Dry Soil Weight (grams):	1272.1	Weight of Soil After Washing (grams) =	218.70
		Difference (grams) =	43.40
		Percent Lost by Washing =	16.56

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	56.2	21.4	21.4	78.6
#4	13.30	5.07	26.52	73.48
#10	7.20	2.75	29.26	70.74
#40	11.90	4.54	33.80	66.20
#100	89.50	34.15	67.95	32.05
#200	39.50	15.07	83.02	16.98
PAN	1.40	17.09	100.11	0.00
TOTAL	219.00	100.11	—	—

% Gravel =	26.52
% Coarse Sand =	2.75
% Medium Sand =	4.54
% Fine Sand =	49.22
% Silt or Clay =	17.09

NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.

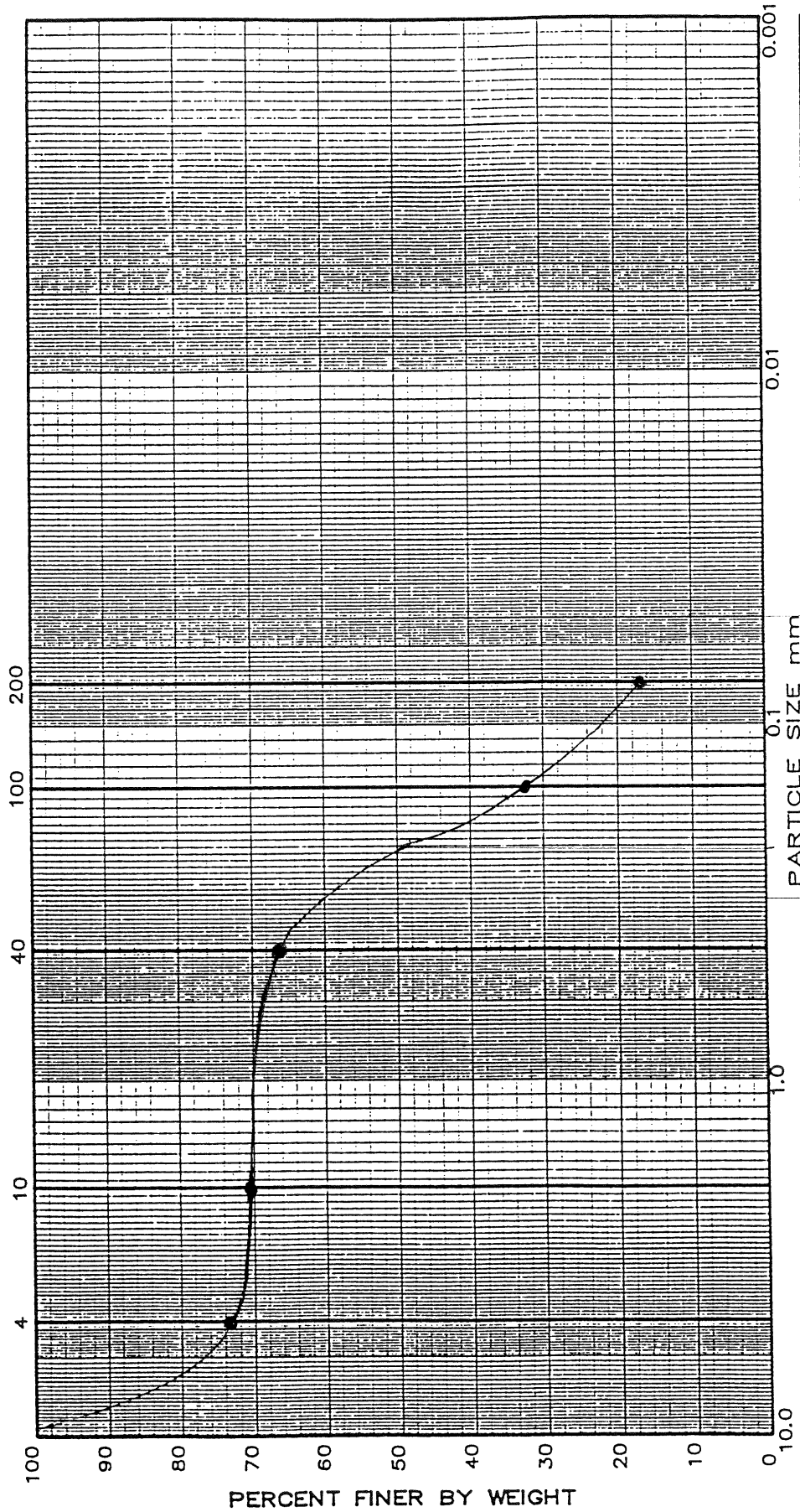
The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.

No definite classification can be made because there was insufficient material to run Atterburg limits and hydrometer.

JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



BORING NO.			SAMPLE NO.		DEPTH	ASTM CLASSIFICATION		SOIL DESCRIPTION
GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND					SILT OR CLAY
26.52	2.75	4.54	49.22					17.09
					159-161'	---		CLAYEY SAND WITH GRAVEL
DB-1								

# ATTERBERG LIMITS DETERMINATION (ASTM D4318-84)

Project Name: LAIDLAW WASTE SYSTEMS  
 Project Number: 940387  
 Task Number: 0004  
 Location of Test: Dell Engineering, Inc.  
 Personnel: JAG

Sample Boring: DB-1  
 Depth of Sample: 179-181', 189-191', 199-201'  
 Sample Source: JAR  
 Date Collected: 7/7/94  
 Date Analyzed: 8/3/94

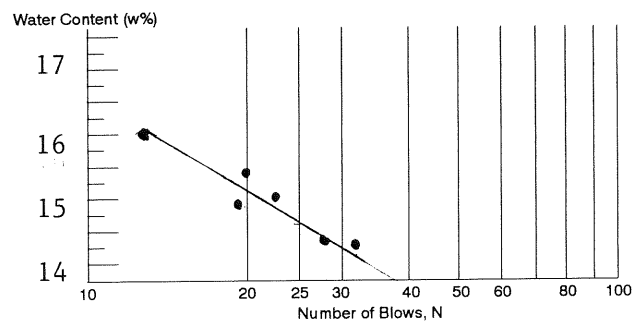
Soil Classification: SC-CLAYEY SAND

## Liquid Limits Determination

Can Number:	1	7	6	12	13	18
Weight of Wet Soil + Can:	34.70	33.90	30.40	28.30	33.20	35.20
Weight of Dry Soil + Can:	31.90	31.40	27.90	26.20	30.70	32.20
Weight Of Can:	14.40	14.00	11.30	11.60	14.50	12.00
Weight of Dry Soil:	17.50	17.40	16.60	14.60	16.20	20.20
Weight of Moisture:	2.80	2.50	2.50	2.10	2.50	3.00
Water Content, (w%):	16.00	14.37	15.06	14.38	15.43	14.85
Number of Blows, (N):	13	28	23	32	20	19

## Plastic Limits Determination

Can Number:	4	9	25	
Weight of Wet Soil + Can:	21.60	24.50	21.80	
Weight of Dry Soil + Can:	20.50	23.30	20.80	
Weight of Can:	11.30	14.00	12.60	
Weight of Dry Soil:	9.20	9.30	8.20	
Weight of Moisture:	1.10	1.20	1.00	
Water Content, (w% = wp):	11.96	12.90	12.20	
Average Water Content =	12.4%			



Liquid Limit = 14.7%  
 Plastic Limit = 12.4%  
 Plasticity Index = 2.3%

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Number	DB-1
Project Number:	940387	Depth of Sample:	179-181', 189-191', 199-201'
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/4/94
Personnel:	JAG		
Soil Classification:	SC-CLAYEY SAND		

LOSS BY WASHING

Pan Weight (grams) =	602.5	Weight of Soil Before Washing (grams) =	300.00
Pan and Dry Soil Weight (grams):	902.5	Weight of Soil After Washing (grams) =	172.80
		Difference (grams) =	127.20
		Percent Lost by Washing =	42.40

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	22.10	7.37	7.37	92.63
#10	8.80	2.93	10.30	89.70
#40	17.40	5.80	16.10	83.90
#100	83.10	27.70	43.80	56.20
#200	39.70	13.23	57.03	42.97
PAN	0.30	42.50	99.53	0.00
TOTAL	171.40	99.53	—	—

% Gravel =	7.37
% Coarse Sand =	2.93
% Medium Sand =	5.80
% Fine Sand =	40.93
% Silt or Clay =	42.50

NOTES

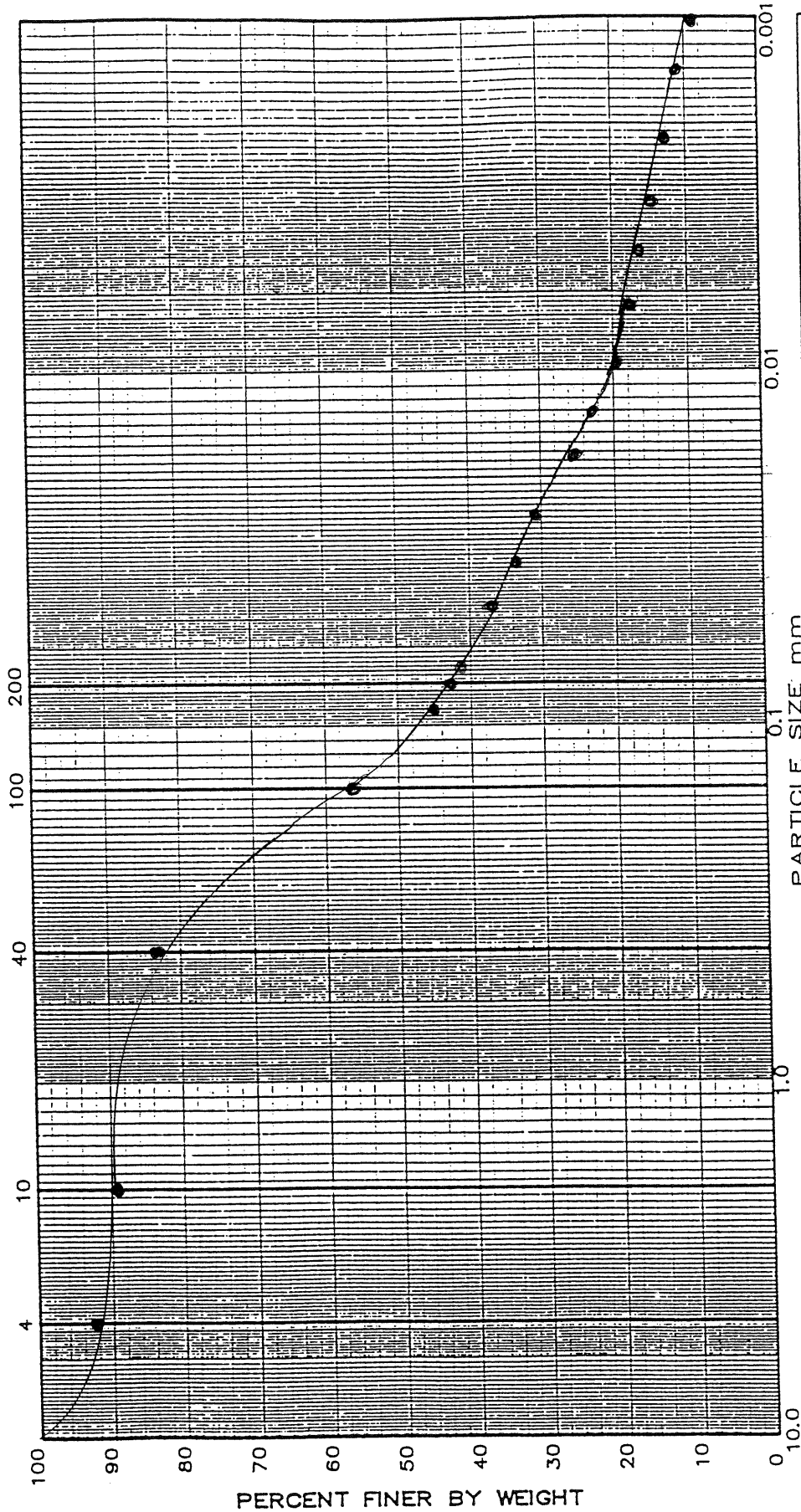
% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.



JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL 7.37	COARSE SAND 2.93	MEDIUM SAND 5.80	FINE SAND 40.93		SILT OR CLAY 42.50
BORING NO. DB-1	SAMPLE NO. --	DEPTH 179-181, 189-191, 199+201'			SOIL DESCRIPTION SAND WITH CLAY
		ASTM CLASSIFICATION SC-CLAYEY SAND			

DELL ENGINEERING, INC. • Environmental Consulting  
3552 128th Avenue, Holland, Michigan 49424-9263



# HYDROMETER (ASTM D-422)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Number:	DB-1
Project Number:	940387	Depth of Sample:	179-181, 189-191, 199-201'
Task Number:	0004	Sample Source:	jar
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/7/94
Personnel:	JAG	Date Analyzed:	8/16/94

Soil Classification: SC-CLAYEY SAND

## -- SAMPLE INFORMATION --

Sample Weight (gm) =	50.0	Specific Gravity (Gs) =	2.69
Total Percent Fines =	42.50%	Test Sample Fraction Used - Passing # 40 Sieve	

Date	Time	Elapsed Time (min)	Temp (C)	Hydrometer Reading (Ra)	Temp Correction (Ct)	Corrected Reading (Rc)	% Finer	Corrected % Finer	Meniscus Correction (R)	L	L/t	Diameter (mm)
8/16/94	10:00	0.25	20	31	0.0	25	49.6	44.9	32	11.21	44.84	0.0924
		0.5	20	29	0.0	23	45.6	41.3	30	11.54	23.08	0.0663
	10:01	1	20	27	0.0	21	41.7	37.7	28	11.87	11.87	0.0475
	10:02	2	20	25	0.0	19	37.7	34.1	26	12.2	6.10	0.0341
	10:04	4	20	23	0.0	17	33.7	30.5	24	12.52	3.13	0.0244
	10:08	8	20	20	0.0	14	27.8	25.1	21	13.02	1.63	0.0176
	10:15	15	20	19	0.0	13	25.8	23.3	20	13.18	0.88	0.0129
	10:30	30	20	17	0.0	11	21.8	19.8	18	13.51	0.45	0.0093
	11:00	60	20	16	0.0	10	19.8	18.0	17	13.67	0.23	0.0066
	12:00	120	20	15	0.0	9	17.9	16.2	16	13.84	0.12	0.0047
	14:00	240	20	14	0.0	8	15.9	14.4	15	14	0.06	0.0033
	18:00	480	20	13	0.0	7	13.9	12.6	14	14.16	0.03	0.0024
8/17/94	10:00	1440	20	12	0.0	6	11.9	10.8	13	14.33	0.01	0.0014
8/18/94	10:00	2880	20	11	0.0	5	9.9	9.0	12	14.00	0.00	0.0010

Correction for Gs = 0.99

Zero Correction = 6

Unit Weight of Soil Solids and Temperature Combination Constant (K) = 0.01380

Percent Finer Correction:

Interpolate Hydrometer Data to determine % Finer at 0.075mm (#200 sieve)

% Finer (From Hydrometer Analysis) at 0.075mm = 46.95%

Establish Correction Factor to Correlate % Passing #200 Sieve to Finer % in Hydrometer Analysis

% Finer Correction = 0.9051

## NOTES:

Although the sample included all particles which passed the #40 sieve, the Corrected % Finer was computed to reflect all particles which passed the #200 sieve during the sieve analysis.

**SPECIFIC GRAVITY  
(ASTM D-854)**

Project Name: LAIDLAW WASTE SYSTEMS

Project Number: 940387 Task Number: 0004 Activity Number: -----

Date: 8/4/94 Personnel: JAG

Location of Test: DELL ENGINEERING, INC. Sample Source: JAR Sample Boring: DB-1

Soil Classification: SC - CLAYEY SAND Depth of Sample: 179-181', 189-191', 199-201'

TEST NUMBER:				
Volumetric Flask Number	2	2		
Volume of Flask	500.0	500.0		
Weight of Flask + Water Filled to Mark, $W_1$ (g)	677.6	677.6		
Weight of Flask + Soil + Water Filled to Mark, $W_2$ (g)	709.0	709.0		
Weight of Dry Soil, $W_3$ (g)	50.0	50.0		
Temperature of Test, $T_1$ °C	20.0	20.0		
$G_s$ (at $T_1$ °C) = $\frac{W_3}{(W_1 + W_3) - W_2}$	2.69	2.69		
Temperature Correction Factor, K	1.0	1.0		
$G_s$ (at 20 °C) = $K \times G_s$ (at $T$ °C)	2.69	2.69		

# ATTERBERG LIMITS DETERMINATION (ASTM D4318-84)

Project Name: LAIDLAW WASTE SYSTEMS  
 Project Number: 940387  
 Task Number: 0004  
 Location of Test: Dell Engineering, Inc.  
 Personnel: JAG

Sample Boring: DB-2  
 Depth of Sample: 42-44'  
 Sample Source: SHELBY TUBE  
 Date Collected: 7/12/94  
 Date Analyzed: 7/25/94

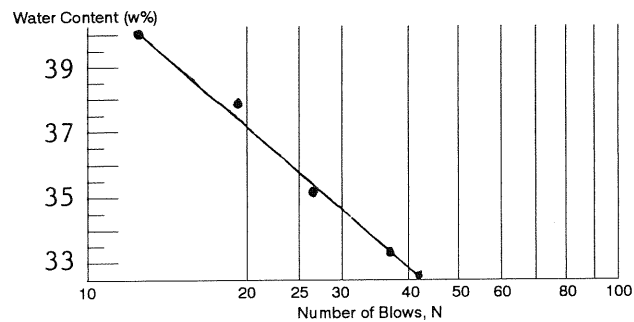
Soil Classification: CL-LEAN CLAY WITH SAND

## Liquid Limits Determination

Can Number:	5	8	9	17	18	
Weight of Wet Soil + Can:	31.30	25.70	28.30	28.70	29.30	
Weight of Dry Soil + Can:	27.00	22.10	24.50	24.70	24.30	
Weight Of Can:	13.80	11.40	13.70	14.10	11.80	
Weight of Dry Soil:	13.20	10.70	10.80	10.60	12.50	
Weight of Moisture:	4.30	3.60	3.80	4.00	5.00	
Water Content, (w%):	32.58	33.64	35.19	37.74	40.00	
Number of Blows, (N):	41	38	27	19	13	

## Plastic Limits Determination

Can Number:	15	13	25	27
Weight of Wet Soil + Can:	29.40	23.70	24.80	23.40
Weight of Dry Soil + Can:	26.70	22.20	22.90	22.10
Weight of Can:	11.40	14.10	12.60	14.40
Weight of Dry Soil:	15.30	8.10	10.30	7.70
Weight of Moisture:	2.70	1.50	1.90	1.30
Water Content, (w% = wp):	17.65	18.52	18.45	16.88
Average Water Content =	17.9%			



Liquid Limit = 36.1%  
 Plastic Limit = 17.9%  
 Plasticity Index = 18.2%

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring	DB-2
Project Number:	940387	Depth of Sample:	42-44' BGS
Task Number:	0004	Sample Source:	SHELBY TUBE
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	7/26/94
Personnel:	JAG		

Soil Classification                      CL-LEAN CLAY WITH SAND

LOSS BY WASHING

Pan Weight (grams) =	655.5	Weight of Soil Before Washing (grams) =	400.00
Pan and Dry Soil Weight (grams):	1055.5	Weight of Soil After Washing (grams) =	80.10
		Difference (grams) =	319.90
		Percent Lost by Washing =	79.98

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	2.20	0.55	0.55	99.45
#10	3.80	0.95	1.50	98.50
#40	8.80	2.20	3.70	96.30
#100	42.70	10.68	14.38	85.63
#200	22.60	5.65	20.03	79.98
PAN	0.00	79.98	100.00	0.00
TOTAL	80.10	100.00	—	—

% Gravel =	0.55
% Coarse Sand =	0.95
% Medium Sand =	2.20
% Fine Sand =	16.33
% Silt or Clay =	79.98

NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.

The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.

HYDRAULIC CONDUCTIVITY  
(FLEXIBLE-WALL PERMEAMETER)  
(ASTM D-5084)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Location:	DB-2
Project Number:	940387	Depth of Sample:	42-44'
Task Number:	0004	Sample Source:	Shelby Tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/12/94
Personnel:	JAG	Report Date:	8/19/94

Soil Classification: CL-LEAN CLAY WITH SAND

--SAMPLE INFORMATION--

Soil Type:	CLAY	Permeameter #:	5
Height (cm):	5.2	Permeant:	.01 N CASO <sub>4</sub>
Diameter (cm):	7.2	Upper Burette Area:	1.976
Area (cm <sup>2</sup> ):	40.7	Upper Burette Pressure (psi):	25.0
Volume (cm <sup>3</sup> ):	211.7	Lower Burette Area (cm <sup>2</sup> ):	1.976
Initial Weight (grams):	457.7	Lower Burette Pressure (psi):	27.0
Initial Moisture Content:	18.80%	Chamber Pressure (psi):	30.0
Final Weight (grams):	458.50	Pressure Gradient:	27.1
Final Moisture Content:	19.10%	alpha:	0.126
Specific Gravity:	2.70		

Elapsed Time (min)	V (ml) up	V (ml) low	Head (cm)	Dt (min)	Dt (sec)	Ln (Ht/Ht)	Permeability (K at T)	Temp C	Permeability (K at T=20)
0	50.0	11.6	160.3	0	0	—	—	21.0	—
2820	50.0	15.8	158.2	2820	169200	1.3E-02	9.96E-09	21.0	9.71E-09
3360	49.6	16.4	157.6	540	32400	3.2E-03	1.25E-08	21.0	1.22E-08
4260	49.0	17.4	156.8	900	54000	5.1E-03	1.20E-08	21.0	1.17E-08
4620	48.6	17.8	156.4	360	21600	2.6E-03	1.51E-08	21.0	1.47E-08
4740	48.6	18.0	156.3	120	7200	6.5E-04	1.13E-08	21.0	1.11E-08
8580	45.2	21.6	152.8	3840	230400	2.3E-02	1.26E-08	21.0	1.22E-08
9120	44.8	22.0	152.4	540	32400	2.7E-03	1.03E-08	21.0	1.01E-08
10020	44.0	23.0	151.5	900	54000	6.0E-03	1.40E-08	21.0	1.37E-08
10320	43.8	23.2	151.3	300	18000	1.3E-03	9.38E-09	21.0	9.15E-09
12900	41.2	26.0	148.5	2580	154800	1.8E-02	1.49E-08	21.0	1.45E-08
14580	39.2	28.0	146.5	1680	100800	1.4E-02	1.72E-08	21.0	1.68E-08
18380	34.8	32.8	141.9	3800	228000	3.2E-02	1.79E-08	21.0	1.74E-08
21540	32.0	36.0	138.8	3160	189600	2.2E-02	1.44E-08	21.0	1.41E-08
24420	28.6	39.2	135.5	14100	846000	1.1E-01	1.64E-08	21.0	1.60E-08

Average Stabilized Permeability, K(cm/sec) = 1.31E-08

Notes:

1. N.A. = Not available
2. — = Averaging ended

**SPECIFIC GRAVITY**  
(ASTM D-854)

Project Name: LAIDLAW WASTE SYSTEMS

Project Number: 940387 Task Number: 0004 Activity Number: -----

Date: 7/27/94 Personnel: JAG

Location of Test: DELL ENGINEERING, INC. Sample Source: SHELBY TUBE Sample Boring: DB-2

Soil Classification: CL - LEAN CLAY WITH SAND Depth of Sample: 42 - 44' BGS

TEST NUMBER:	1	2		
Volumetric Flask Number	2	2		
Volume of Flask	500.0	500.0		
Weight of Flask + Water Filled to Mark, $W_1$ (g)	677.6	677.6		
Weight of Flask + Soil + Water Filled to Mark, $W_2$ (g)	709.0	709.1		
Weight of Dry Soil, $W_3$ (g)	50.0	50.0		
Temperature of Test, $T_1$ °C	20.0	20.0		
$G_s$ (at $T_1$ °C) = $\frac{W_3}{(W_1 + W_3) - W_2}$	2.69	2.70		
Temperature Correction Factor, K	1.0	1.0		
$G_s$ (at 20 °C) = $K \times G_s$ (at $T$ °C)	2.69	2.70		

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring	DB-2
Project Number:	940387	Depth of Sample:	135-137' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	7/28/94
Personnel:	JAG		

Soil Classification                      SP-POORLY GRADED SAND

LOSS BY WASHING

Pan Weight (grams) =	480.0	Weight of Soil Before Washing (grams) =	172.00
Pan and Dry Soil Weight (grams):	652.0	Weight of Soil After Washing (grams) =	164.90
		Difference (grams) =	7.10
		Percent Lost by Washing =	4.13

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	0.00	0.00	0.00	100.00
#10	0.00	0.00	0.00	100.00
#40	1.80	1.05	1.05	98.95
#100	142.30	82.73	83.78	16.22
#200	20.80	12.09	95.87	4.13
PAN	0.00	4.13	100.00	0.00
TOTAL	164.90	100.00	-	-

% Gravel =	0.00
% Coarse Sand =	0.00
% Medium Sand =	1.05
% Fine Sand =	94.83
% Silt or Clay =	4.13

NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.

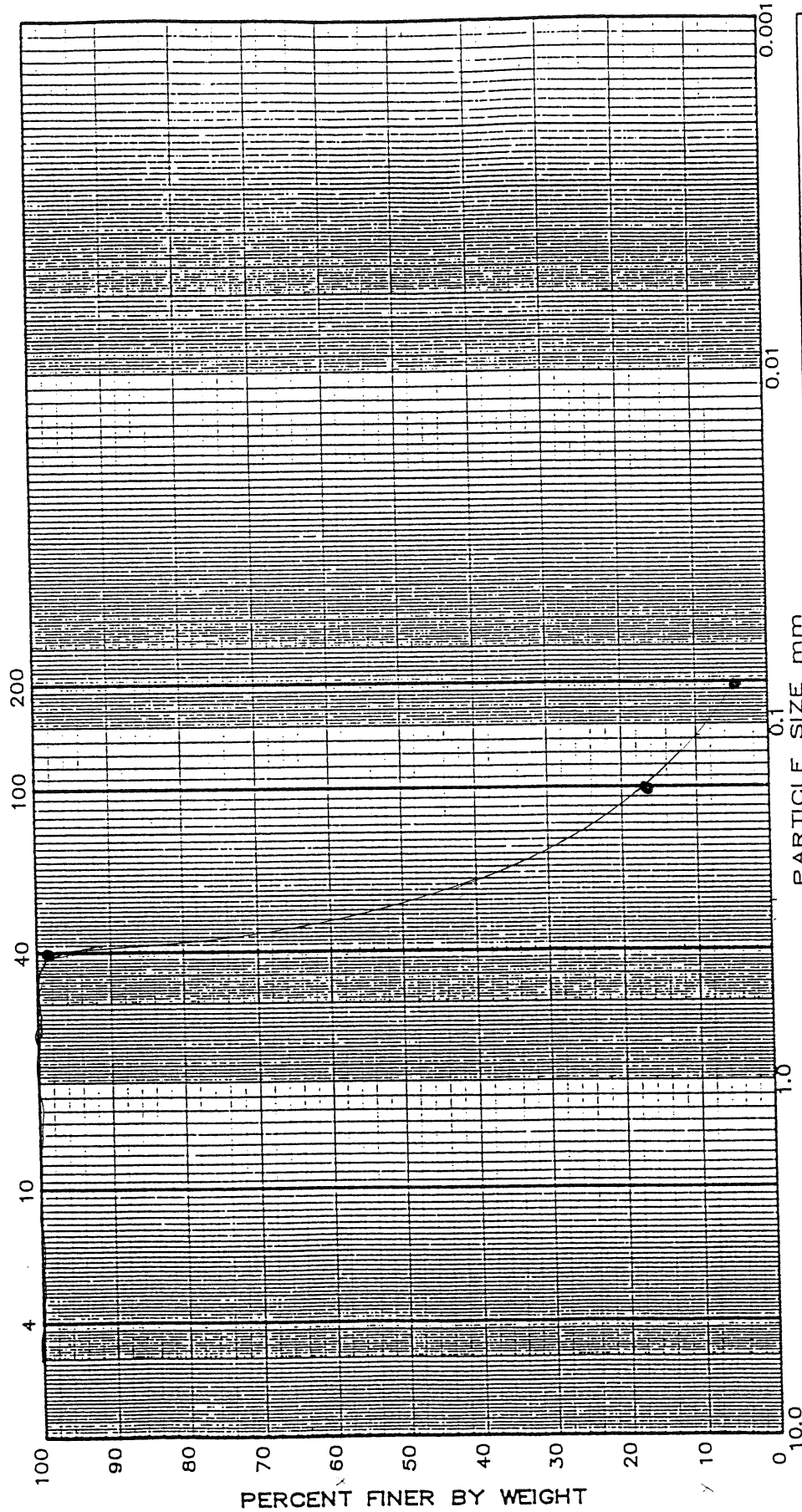
The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.



JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT OR CLAY
0.00	0.00	1.05	94.83	4.13
BORING NO.	SAMPLE NO.	DEPTH	ASTM CLASSIFICATION	SOIL DESCRIPTION
DB-2	--	135-137'	SP-POORLY GRADED SAND	SAND

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-2
Project Number:	940387	Depth of Sample:	184-185.5' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/24/94
Personnel:	JAG		

Soil Description: GRAVEL WITH CLAY AND SAND

## LOSS BY WASHING

Pan Weight (grams) =	301.6	Weight of Soil Before Washing (grams) =	300.00
Pan and Dry Soil Weight (grams):	601.6	Weight of Soil After Washing (grams) =	264.90
		Difference (grams) =	35.10
		Percent Lost by Washing =	11.70

## Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	76.8	25.6	25.6	74.4
#4	74.00	24.67	50.27	49.73
#10	25.90	8.63	58.90	41.10
#40	24.30	8.10	67.00	33.00
#100	44.20	14.73	81.73	18.27
#200	18.80	6.27	88.00	12.00
PAN	0.20	11.77	99.77	0.00
TOTAL	264.20	99.77	—	—

% Gravel =	50.27
% Coarse Sand =	8.63
% Medium Sand =	8.10
% Fine Sand =	21.00
% Silt or Clay =	11.77

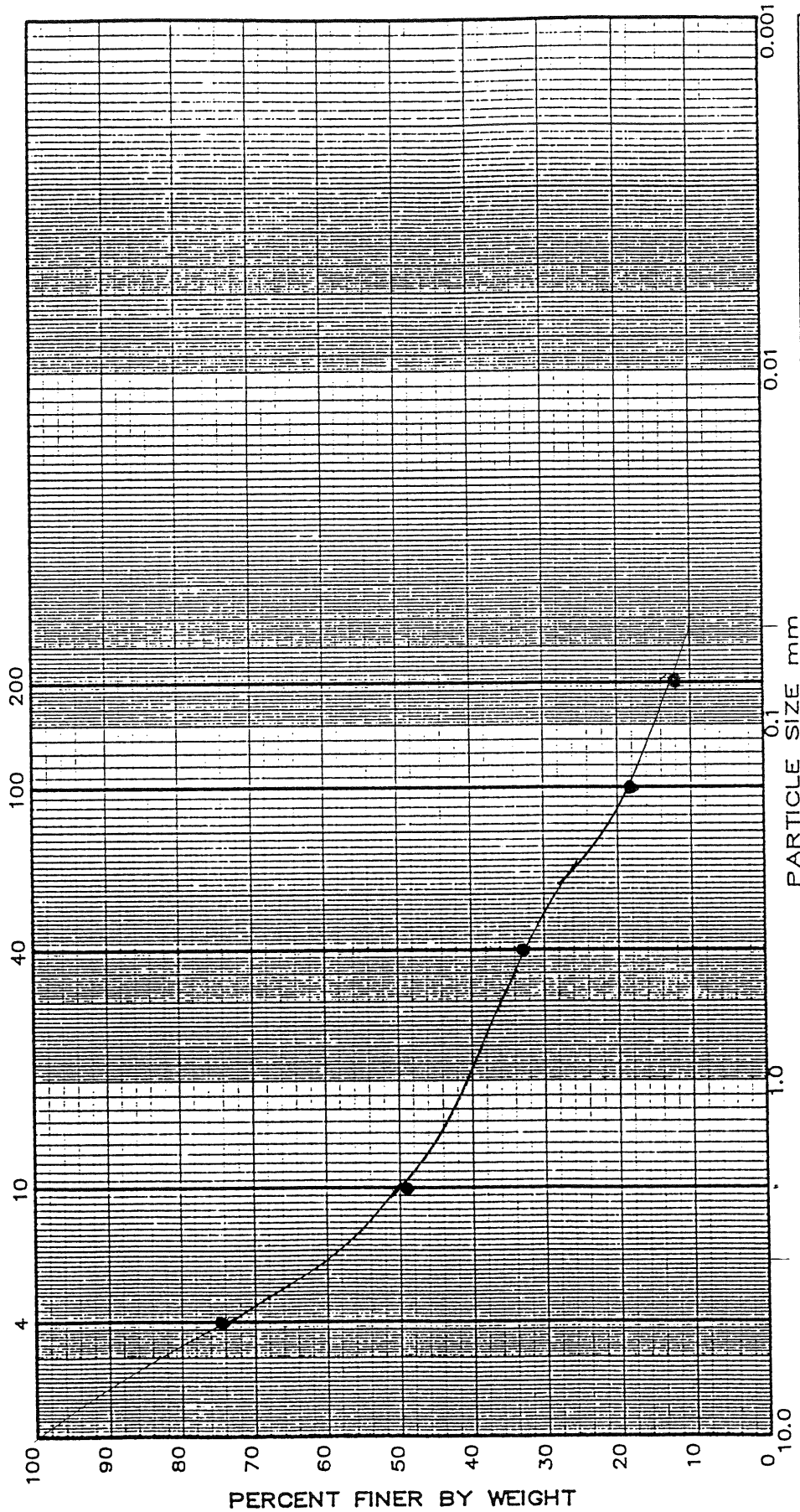
## NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
 The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.  
 No definite classification can be made because there is insufficient material to run atterburg limits on the fines. Classification is either GW-GM or most likely GW-GC.

JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT OR CLAY
50.27	8.63	8.10	21.00	11.77
BORING NO.	SAMPLE NO.	DEPTH	ASTM CLASSIFICATION	SOIL DESCRIPTION
DB-2	--	184-185.5'	---	GRAVEL WITH CLAY AND SAND

# ATTERBERG LIMITS DETERMINATION (ASTM D4318-84)

Project Name: LAIDLAW WASTE SYSTEMS  
 Project Number: 940387  
 Task Number: 0004  
 Location of Test: Dell Engineering, Inc.  
 Personnel: JAG

Sample Boring: DB-3  
 Depth of Sample: 54-56'  
 Sample Source: SHELBY TUBE  
 Date Collected: 7/12/94  
 Date Analyzed: 8/23/94

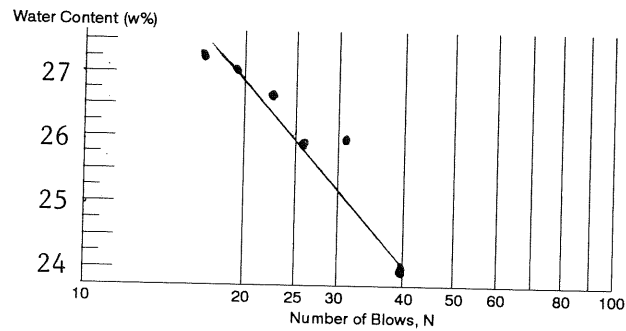
Soil Classification: CL-SANDY LEAN CLAY

## Liquid Limits Determination

Can Number:	7	9	14	15	25	27
Weight of Wet Soil + Can:	32.20	28.90	29.70	29.10	31.80	29.80
Weight of Dry Soil + Can:	28.70	25.80	25.90	26.00	27.70	26.30
Weight Of Can:	14.10	13.80	11.60	14.00	12.50	13.40
Weight of Dry Soil:	14.60	12.00	14.30	12.00	15.20	12.90
Weight of Moisture:	3.50	3.10	3.80	3.10	4.10	3.50
Water Content, (w%):	23.97	25.83	26.57	25.83	26.97	27.13
Number of Blows, (N):	40	31	23	26	19	17

## Plastic Limits Determination

Can Number:	2	6	18
Weight of Wet Soil + Can:	20.00	20.50	25.00
Weight of Dry Soil + Can:	19.00	19.30	23.40
Weight of Can:	12.10	11.40	12.00
Weight of Dry Soil:	6.90	7.90	11.40
Weight of Moisture:	1.00	1.20	1.60
Water Content, (w%=wp):	14.49	15.19	14.04
Average Water Content =	14.6%		



Liquid Limit = 26.1%  
 Plastic Limit = 14.6%  
 Plasticity Index = 11.5%

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-3
Project Number:	940387	Depth of Sample:	54-56' BGS
Task Number:	0004	Sample Source:	SHELBY TUBE
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/24/94
Personnel:	JAG		

Soil Classification: CL-SANDY LEAN CLAY

## LOSS BY WASHING

Pan Weight (grams) =	200.0	Weight of Soil Before Washing (grams) =	300.00
Pan and Dry Soil Weight (grams):	500.0	Weight of Soil After Washing (grams) =	91.90
		Difference (grams) =	208.10
		Percent Lost by Washing =	69.37

## Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	4.00	1.33	1.33	98.67
#10	4.40	1.47	2.80	97.20
#40	9.30	3.10	5.90	94.10
#100	43.20	14.40	20.30	79.70
#200	30.80	10.27	30.57	69.43
PAN	0.20	69.43	100.00	0.00
TOTAL	91.90	100.00	-	-

% Gravel =	1.33
% Coarse Sand =	1.47
% Medium Sand =	3.10
% Fine Sand =	24.67
% Silt or Clay =	69.43

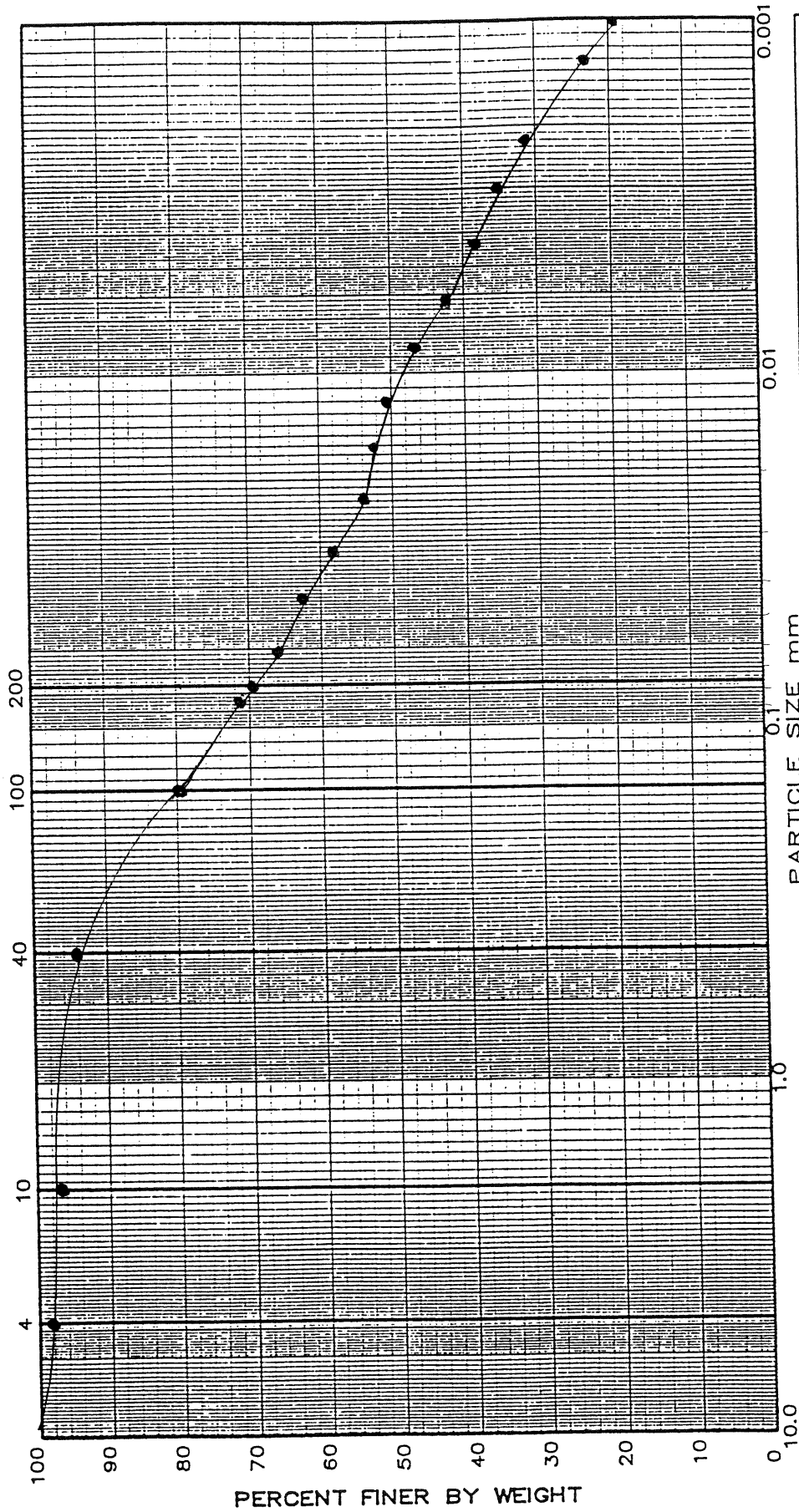
## NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.

JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL		COARSE SAND		MEDIUM SAND		FINE SAND		SILT OR CLAY	
1.33		1.47		3.10		24.67		69.43	
BORING NO.		SAMPLE NO.		DEPTH		ASTM CLASSIFICATION		SOIL DESCRIPTION	
DB-3		--		54-56'		CL-SANDY LEAN CLAY		CLAY WITH SAND	

# HYDROMETER (ASTM D-422)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-3
Project Number:	940387	Depth of Sample:	54-56'
Task Number:	0004	Sample Source:	shelby tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/12/94
Personnel:	JAG	Date Analyzed:	8/24/94

Soil Classification: CL-SANDY LEAN CLAY

## -- SAMPLE INFORMATION --

Sample Weight (gm) =	50.0	Specific Gravity (Gs) =	2.64
Total Percent Fines =	69.43%	Test Sample Fraction Used -	Passing # 40 Sieve

Date	Time	Elapsed Time (min)	Temp (C)	Hydrometer Reading (Ra)	Temp Correction (Ct)	Corrected Reading (Rc)	% Finer	Corrected % Finer	Meniscus Correction (R)	L	L/t	Diameter (mm)
8/24/94	10:00	0.25	20	43	0.0	37	74.1	71.7	44	9.243	36.97	0.0839
		0.5	20	40	0.0	34	68.1	65.9	41	9.735	19.47	0.0609
	10:01	1	20	38	0.0	32	64.1	62.0	39	10.06	10.06	0.0438
	10:02	2	20	36	0.0	30	60.1	58.1	37	10.39	5.20	0.0315
	10:04	4	20	34	0.0	28	56.1	54.2	35	10.72	2.68	0.0226
	10:08	8	20	33	0.0	27	54.1	52.3	34	10.88	1.36	0.0161
	10:15	15	20	32	0.0	26	52.1	50.4	33	11.05	0.74	0.0118
	10:30	30	20	30	0.0	24	48.1	46.5	31	11.38	0.38	0.0085
	11:00	60	20	28	0.0	22	44.1	42.6	29	11.7	0.20	0.0061
	12:00	120	20	26	0.0	20	40.1	38.7	27	12.03	0.10	0.0044
	14:00	240	20	24	0.0	18	36.1	34.9	25	12.36	0.05	0.0031
	18:00	480	20	22	0.0	16	32.1	31.0	23	12.69	0.03	0.0022
8/25/94	10:00	1440	20	18	0.0	12	24.0	23.2	19	13.34	0.01	0.0013
8/26/94	10:00	2880	20	16	0.0	10	20.0	19.4	17	14.00	0.00	0.0010

Correction for Gs = 1.00

Zero Correction = 6

Unit Weight of Soil Solids and Temperature Combination Constant (K) = 0.01380

Percent Finer Correction:

Interpolate Hydrometer Data to determine % Finer at 0.075mm (#200 sieve)

% Finer (From Hydrometer Analysis) at 0.075mm = 71.82%

Establish Correction Factor to Correlate % Passing #200 Sieve to Finer % in Hydrometer Analysis

% Finer Correction = 0.9667

## NOTES:

Although the sample included all particles which passed the #40 sieve, the Corrected % Finer was computed to reflect all particles which passed the #200 sieve during the sieve analysis.

HYDRAULIC CONDUCTIVITY  
(FLEXIBLE – WALL PERMEAMETER)  
(ASTM D – 5084)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Location:	DB-3
Project Number:	940387	Depth of Sample:	54-56' BGS
Task Number:	0004	Sample Source:	Shelby Tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/12/94
Personnel:	JAG	Report Date:	9/14/94

Soil Classification: CL – SANDY LEAN CLAY

--SAMPLE INFORMATION--

Soil Type:	CLAY	Permeameter #:	3
Height (cm):	5.6	Permeant:	.01 N CASO <sub>4</sub>
Diameter (cm):	7.2	Upper Burette Area:	2.033
Area (cm <sup>2</sup> ):	40.7	Upper Burette Pressure (psi):	25.0
Volume (cm <sup>3</sup> ):	228.0	Lower Burette Area (cm <sup>2</sup> ):	2.048
Initial Weight (grams):	507.6	Lower Burette Pressure (psi):	28.0
Initial Moisture Content:	15.87%	Chamber Pressure (psi):	30.0
Final Weight (grams):	504.80	Pressure Gradient:	37.7
Final Moisture Content:	14.03%	alpha:	0.141
Specific Gravity:	2.64		

Elapsed Time (min)	V (ml) up	V (ml) low	Head (cm)	Dt (min)	Dt (sec)	Ln (Ht/Ht)	Permeability (K at T)	Temp C	Permeability (K at T=20)
0	48.2	4.6	232.6	0	0	—	—	21.0	—
1020	49.0	7.8	231.4	1020	61200	5.0E-03	1.16E-08	21.0	1.13E-08
2460	47.6	9.4	229.9	1440	86400	6.4E-03	1.04E-08	21.0	1.01E-08
3960	46.0	11.0	228.3	1500	90000	6.8E-03	1.07E-08	21.0	1.04E-08
4380	45.4	11.6	227.8	420	25200	2.6E-03	1.44E-08	21.0	1.41E-08
8220	42.0	15.8	224.0	3840	230400	1.6E-02	1.01E-08	21.0	9.83E-09
8700	41.6	16.2	223.6	480	28800	1.8E-03	8.56E-09	21.0	8.35E-09
9660	40.6	17.4	222.6	960	57600	4.8E-03	1.18E-08	21.0	1.15E-08
9960	40.4	17.6	222.4	300	18000	8.8E-04	6.89E-09	21.0	6.72E-09
11100	39.2	18.8	221.2	1140	68400	5.3E-03	1.09E-08	21.0	1.07E-08
11460	38.8	19.2	220.8	360	21600	1.8E-03	1.16E-08	21.0	1.13E-08

Average Stabilized Permeability, K(cm/sec) = 1.03E-08

Notes:

1. N.A. = Not available
2. — = Averaging ended



**SPECIFIC GRAVITY  
(ASTM D-854)**

Project Name: LAIDLAW WASTE SYSTEMS

Project Number: 940387 Task Number: 0004 Activity Number: \_\_\_\_\_

Date: 8/24/94 Personnel: JAG

Location of Test: DELL ENGINEERING, INC. Sample Source: SHELBY TUBE Sample Boring: DB-3

Soil Classification: CL-SANDY LEAN CLAY Depth of Sample: 54-56'

TEST NUMBER:	1	2		
Volumetric Flask Number	2	2		
Volume of Flask	500.0	500.0		
Weight of Flask + Water Filled to Mark, $W_1$ (g)	677.6	677.6		
Weight of Flask + Soil + Water Filled to Mark, $W_2$ (g)	708.6	708.7		
Weight of Dry Soil, $W_3$ (g)	50.0	50.0		
Temperature of Test, $T_1$ °C	20.0	20.0		
$G_s$ (at $T_1$ °C) = $\frac{W_3}{(W_1 + W_3) - W_2}$	2.63	2.65		
Temperature Correction Factor, K	1.0	1.0		
$G_s$ (at 20 °C) = $K \times G_s$ (at $T$ °C)	2.63	2.65		

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring	DB-3
Project Number:	940387	Depth of Sample:	124-125' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	7/29/94
Personnel:	JAG		

Soil Classification                      SP-POORLY GRADED SAND

LOSS BY WASHING

Pan Weight (grams) =	1010.0	Weight of Soil Before Washing (grams) =	281.20
Pan and Dry Soil Weight (grams):	1291.2	Weight of Soil After Washing (grams) =	276.20
		Difference (grams) =	5.00
		Percent Lost by Washing =	1.78

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	0.00	0.00	0.00	100.00
#10	3.50	1.24	1.24	98.76
#40	198.10	70.45	71.69	28.31
#100	69.70	24.79	96.48	3.52
#200	4.70	1.67	98.15	1.85
PAN	0.00	1.78	99.93	0.00
TOTAL	276.00	99.93	—	—

% Gravel =	0.00
% Coarse Sand =	1.24
% Medium Sand =	70.45
% Fine Sand =	26.46
% Silt or Clay =	1.78

NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.

The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.



SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-3
Project Number:	940387	Depth of Sample:	134-136', 139.5-141.5' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/22/94
Personnel:	JAG		

Soil Description: CLAY WITH SAND

LOSS BY WASHING

Pan Weight (grams) =	300.0	Weight of Soil Before Washing (grams) =	185.00
Pan and Dry Soil Weight (grams):	485.0	Weight of Soil After Washing (grams) =	80.90
		Difference (grams) =	104.10
		Percent Lost by Washing =	56.27

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	0.00	0.00	0.00	100.00
#10	0.80	0.43	0.43	99.57
#40	2.50	1.35	1.78	98.22
#100	39.80	21.51	23.30	76.70
#200	36.50	19.73	43.03	56.97
PAN	0.70	56.65	99.68	0.00
TOTAL	80.30	99.68	—	—

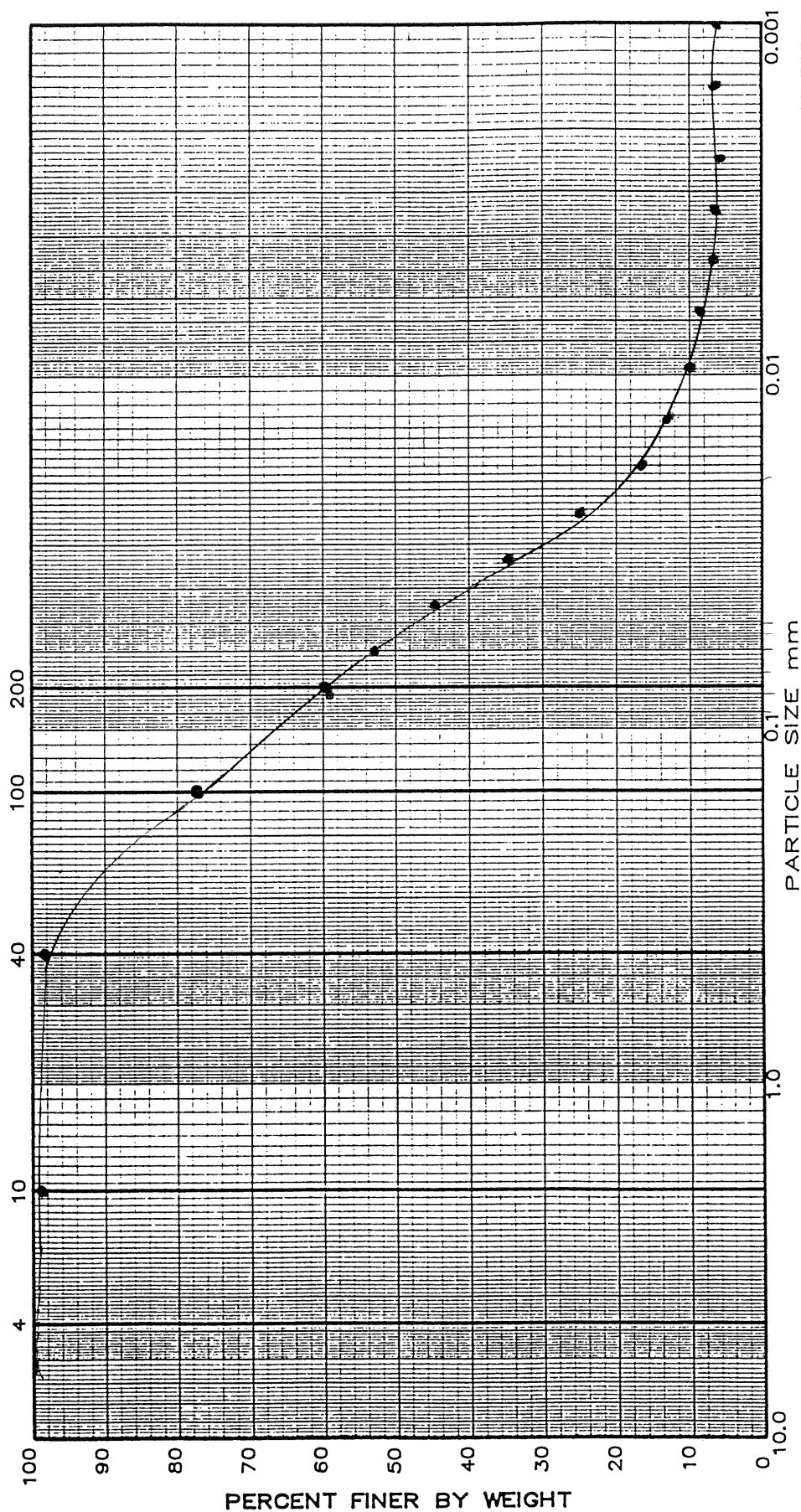
% Gravel =	0.00
% Coarse Sand =	0.43
% Medium Sand =	1.35
% Fine Sand =	41.24
% Silt or Clay =	56.65

NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
 The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.  
 No atterburg limits were performed due to lack of material. The classification is Cl, Cl-ML, or ML.

DATE 9/1/94

## U.S. STANDARD SIEVE SIZE



PARTICLE SIZE LIMIT					SOIL DESCRIPTION
GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT OR CLAY	
0.00	0.43	1.35	41.24	56.65	CLAY WITH SAND
BORING NO. DB-3 SAMPLE NO. -- DEPTH 134-136, 139.5-141.5 ASTM CLASSIFICATION --					

**DELL ENGINEERING, INC.** Particle Size Distribution  
Civil Engineering • Environmental Consulting  
3352 128th Avenue, Holland, Michigan 49424-9263

HYDROMETER  
(ASTM D-422)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-3
Project Number:	940387	Depth of Sample:	134-136', 139.5-141.5'
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/19/94
Personnel:	JAG	Date Analyzed:	8/24/94

Soil Description: CLAY WITH SAND

-- SAMPLE INFORMATION --

Sample Weight (gm) =	50.0	Specific Gravity (Gs) =	2.73
Total Percent Fines =	56.65%	Test Sample Fraction Used -	Passing # 40 Sieve

Date	Time	Elapsed Time (min)	Temp (C)	Hydrometer Reading (Ra)	Temp Correction (Ct)	Corrected Reading (Rc)	% Finer	Corrected % Finer	Meniscus Correction (R)	L	L/t	Diameter (mm)
8/24/94	10:00	0.25	20	42	0.0	36	70.8	59.5	43	9.407	37.63	0.0847
		0.5	20	38	0.0	32	63.0	52.8	39	10.06	20.13	0.0619
	10:01	1	20	33	0.0	27	53.1	44.6	34	10.88	10.88	0.0455
	10:02	2	20	27	0.0	21	41.3	34.7	28	11.87	5.93	0.0336
	10:04	4	20	21	0.0	15	29.5	24.8	22	12.85	3.21	0.0247
	10:08	8	20	16	0.0	10	19.7	16.5	17	13.67	1.71	0.0180
	10:15	15	20	14	0.0	8	15.7	13.2	15	14	0.93	0.0133
	10:30	30	20	12	0.0	6	11.8	9.9	13	14.33	0.48	0.0095
	11:00	60	20	11	0.0	5	9.8	8.3	12	14.49	0.24	0.0068
	12:00	120	20	10	0.0	4	7.9	6.6	11	14.66	0.12	0.0048
	14:00	240	20	10	0.0	4	7.9	6.6	11	14.66	0.06	0.0034
	18:00	480	20	10	0.0	4	7.9	6.6	11	14.66	0.03	0.0024
8/25/94	10:00	1440	20	10	0.0	4	7.9	6.6	11	14.66	0.01	0.0014
8/26/94	10:00	2880	20	10	0.0	4	7.9	6.6	11	14.00	0.00	0.0010

Correction for Gs = 0.98

Zero Correction = 6

Unit Weight of Soil Solids and Temperature Combination Constant (K) = 0.01380

Percent Finer Correction:

Interpolate Hydrometer Data to determine % Finer at 0.075mm (#200 sieve)

% Finer (From Hydrometer Analysis) at 0.075mm = 67.51%

Establish Correction Factor to Correlate % Passing #200 Sieve to Finer % in Hydrometer Analysis

% Finer Correction = 0.8392

NOTES:

Although the sample included all particles which passed the #40 sieve, the Corrected % Finer was computed to reflect all particles which passed the #200 sieve during the sieve analysis.

No definite classification can be made due to the lack of material to run atterburg limits.

SPECIFIC GRAVITY  
(ASTM D-854)

Project Name: LAIDLAW WASTE SYSTEMS

Project Number: 940387
 Task Number: 0004
 Activity Number:

Date: 8/23/94
 Personnel: JAG

Location of Test: LAB
 Sample Source: JAR
 Sample Boring: DB-3

Soil Description: CLAY WITH SAND
 Depth of Sample: 134-136, 139.5-141.5'

TEST NUMBER:	1			
Volumetric Flask Number	2			
Volume of Flask	500.0			
Weight of Flask + Water Filled to Mark, W <sub>1</sub> (g)	677.6			
Weight of Flask + Soil + Water Filled to Mark, W <sub>2</sub> (g)	709.3			
Weight of Dry Soil, W <sub>3</sub> (g)	50.0			
Temperature of Test, T <sub>1</sub> °C	20.0			
G <sub>s</sub> (at T <sub>1</sub> °C) = $\frac{W_3}{(W_1 + W_3) - W_2}$	2.73			
Temperature Correction Factor, K	1.0			
G <sub>s</sub> (at 20 °C) = K x G <sub>s</sub> (at T °C)	2.73			

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-3
Project Number:	940387	Depth of Sample:	182-184' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/23/94
Personnel:	JAG		

Soil Description: SAND WITH CLAY

LOSS BY WASHING

Pan Weight (grams) =	501.4	Weight of Soil Before Washing (grams) =	300.00
Pan and Dry Soil Weight (grams):	801.4	Weight of Soil After Washing (grams) =	277.70
		Difference (grams) =	22.30
		Percent Lost by Washing =	7.43

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	0.00	0.00	0.00	100.00
#10	10.90	3.63	3.63	96.37
#40	55.50	18.50	22.13	77.87
#100	178.10	59.37	81.50	18.50
#200	33.00	11.00	92.50	7.50
PAN	0.20	7.50	100.00	0.00
TOTAL	277.70	100.00	-	-

% Gravel =	0.00
% Coarse Sand =	3.63
% Medium Sand =	18.50
% Fine Sand =	70.37
% Silt or Clay =	7.50

NOTES

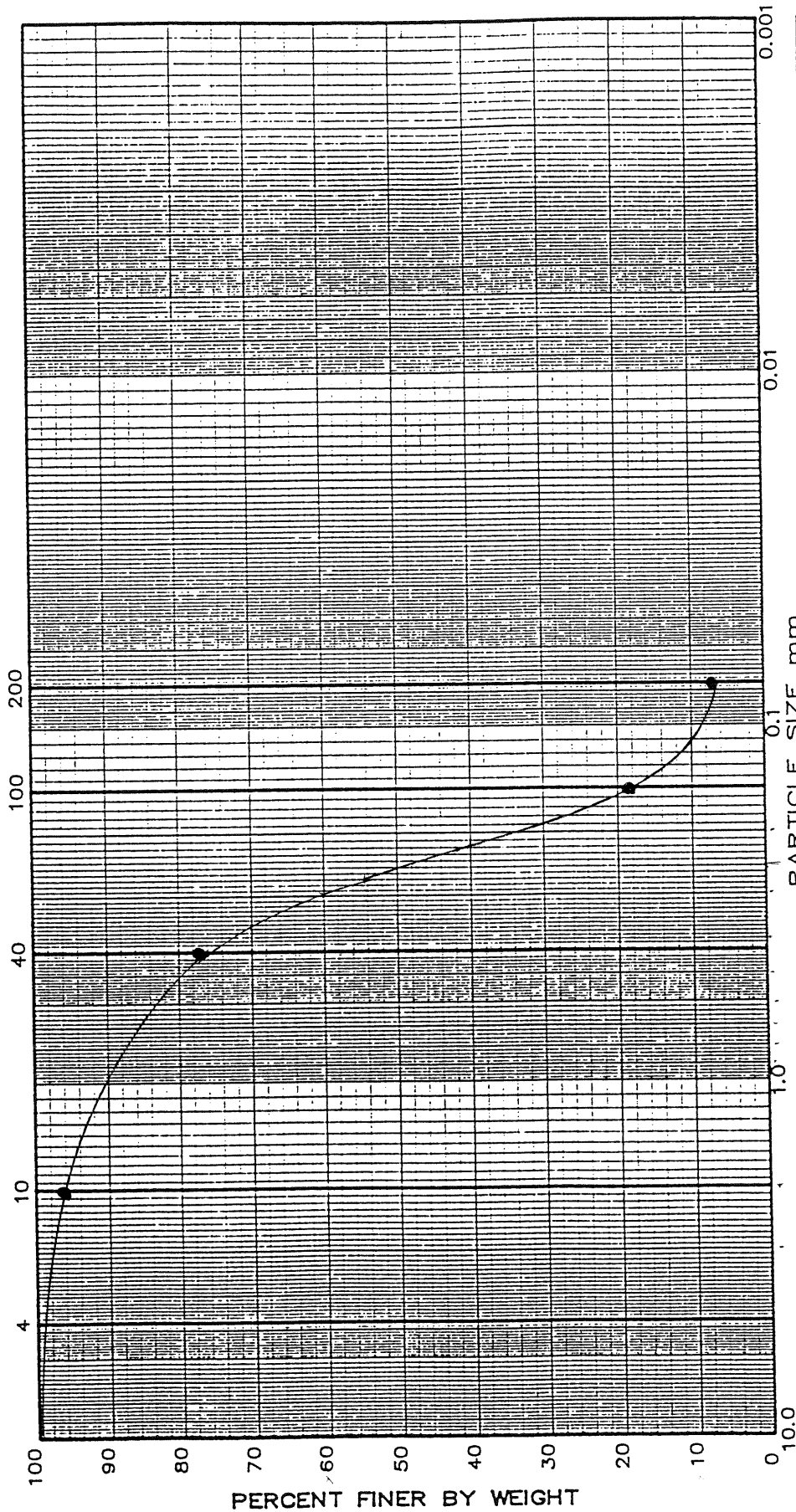
% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
 The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.  
 No definite classification can be made because there is insufficient material to run atterburg limits on the fines. Classification is either SP-SM or most likely SP-SC.



JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT OR CLAY
0.00	3.63	18.50	70.37	7.50
BORING NO.	SAMPLE NO.	DEPTH	ASTM CLASSIFICATION	SOIL DESCRIPTION
DB-3	--	182-184'	---	SAND WITH CLAY

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring	DB-5
Project Number:	940387	Depth of Sample:	38-40' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/23/94
Personnel:	JAG		

Soil Classification                      SP-POORLY GRADED SAND

## LOSS BY WASHING

Pan Weight (grams) =	104.0	Weight of Soil Before Washing (grams) =	176.00
Pan and Dry Soil Weight (grams):	280.0	Weight of Soil After Washing (grams) =	173.00
		Difference (grams) =	3.00
		Percent Lost by Washing =	1.70

## Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	0.00	0.00	0.00	100.00
#10	0.00	0.00	0.00	100.00
#40	0.00	0.00	0.00	100.00
#100	124.40	70.68	70.68	29.32
#200	47.90	27.22	97.90	2.10
PAN	0.20	1.82	99.72	0.00
TOTAL	172.50	99.72	—	—

% Gravel =	0.00
% Coarse Sand =	0.00
% Medium Sand =	0.00
% Fine Sand =	97.90
% Silt or Clay =	1.82

## NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.

DATE 9/1/94

The graph illustrates the particle size distribution of a material. The vertical axis represents the percentage of material finer than a given particle size, ranging from 0 to 100. The horizontal axis represents the particle size in millimeters on a logarithmic scale, ranging from 0.001 to 10.0. A smooth curve is drawn through the following data points:

Particle Size (mm)	Percent Finer (%)
0.075	40
0.15	75
0.3	100
0.6	100

PARTICLE SIZE PERCENT			SOIL DESCRIPTION		
GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT OR CLAY	
0.00	0.00	0.00	97.90	1.82	
BORING NO.		SAMPLE NO.	DEPTH	ASTM CLASSIFICATION	SOIL DESCRIPTION
DB-5		--	38-40'	SP-POORLY GRADED SAND	SAND

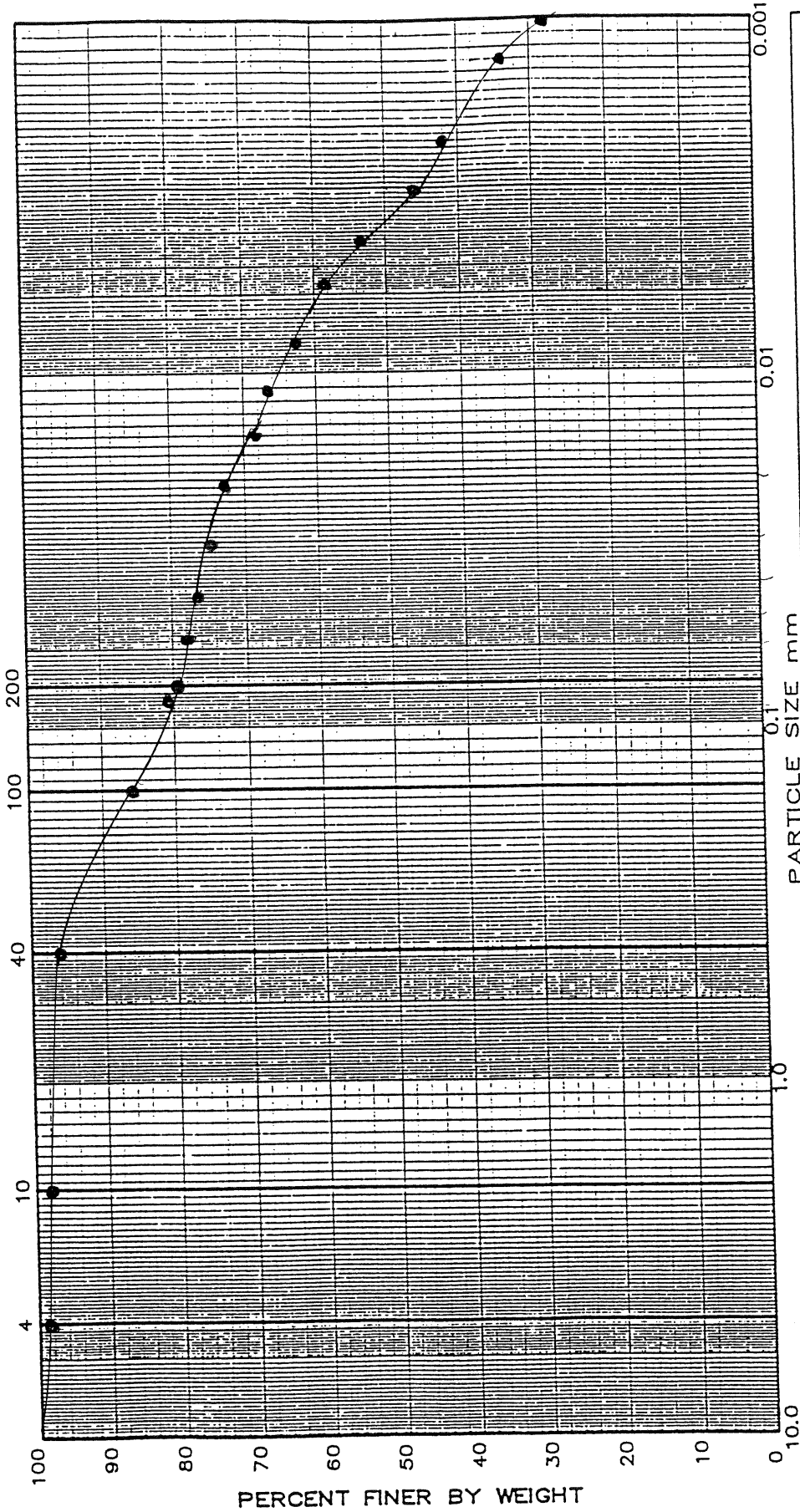
**DELL ENGINEERING, INC.** PARTICLE SIZE DISTRIBUTION  
Civil Engineering • Environmental Consulting  
3352 128th Avenue, Holland, Michigan 49424-9263

**Civil Engineering • Environmental Consulting**  
3352 128th Avenue, Holland, Michigan 49424-9263

JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL		COARSE SAND		MEDIUM SAND		FINE SAND		SILT OR CLAY	
0.55		0.95		2.20		16.33		79.98	
BORING NO.		SAMPLE NO.		DEPTH		ASTM CLASSIFICATION		SOIL DESCRIPTION	
DB-2		--		42-44'		CL-LEAN CLAY WITH SAND		CLAY WITH SAND	

# HYDROMETER (ASTM D-422)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-2
Project Number:	940387	Depth of Sample:	42-44'
Task Number:	0004	Sample Source:	Shelby Tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/12/94
Personnel:	JAG	Date Analyzed:	7/26/94

Soil Classification: CL-LEAN CLAY WITH SAND

## -- SAMPLE INFORMATION --

Sample Weight (gm) =	50.0	Specific Gravity (Gs) =	2.7
Total Percent Fines =	79.98%	Test Sample Fraction Used - Passing # 40 Sieve	

Date	Time	Elapsed Time (min)	Temp (C)	Hydrometer Reading (Ra)	Temp Correction (Ct)	Corrected Reading (Rc)	% Finer	Corrected % Finer	Meniscus Correction (R)	L	L/t	Diameter. (mm)
7/26/94	10:00	0.25	20	46	0.0	40	79.2	80.6	47	8.751	35.00	0.0816
		0.5	20	45	0.0	39	77.2	78.5	46	8.915	17.83	0.0583
	10:01	1	20	44	0.0	38	75.2	76.5	45	9.079	9.08	0.0416
	10:02	2	20	43	0.0	37	73.3	74.5	44	9.243	4.62	0.0297
	10:04	4	20	42	0.0	36	71.3	72.5	43	9.407	2.35	0.0212
	10:08	8	20	40	0.0	34	67.3	68.5	41	9.735	1.22	0.0152
	10:15	15	20	39	0.0	33	65.3	66.5	40	9.899	0.66	0.0112
	10:30	30	20	37	0.0	31	61.4	62.4	38	10.23	0.34	0.0081
	11:00	60	20	35	0.0	29	57.4	58.4	36	10.56	0.18	0.0058
	12:00	120	20	32	0.0	26	51.5	52.4	33	11.05	0.09	0.0042
	14:00	240	20	29	0.0	23	45.5	46.3	30	11.54	0.05	0.0030
	18:00	480	20	27	0.0	21	41.6	42.3	28	11.87	0.02	0.0022
7/27/94	10:00	1440	20	23	0.0	17	33.7	34.2	24	12.52	0.01	0.0013
7/28/94	10:00	2880	20	20	0.0	14	27.7	28.2	21	14.00	0.00	0.0010

Correction for Gs = 0.99

Zero Correction = 6

Unit Weight of Soil Solids and Temperature Combination Constant (K) = 0.01380

Percent Finer Correction:

Interpolate Hydrometer Data to determine % Finer at 0.075mm (#200 sieve)

% Finer (From Hydrometer Analysis) at 0.075mm = 78.64%

Establish Correction Factor to Correlate % Passing #200 Sieve to Finer % in Hydrometer Analysis

% Finer Correction = 1.0171

## NOTES:

Although the sample included all particles which passed the #40 sieve, the Corrected % Finer was computed to reflect all particles which passed the #200 sieve during the sieve analysis.

HYDROMETER  
(ASTM D-422)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-5
Project Number:	940387	Depth of Sample:	53-55'
Task Number:	0004	Sample Source:	Shelby Tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/12/94
Personnel:	JAG	Date Analyzed:	7/27/94

Soil Classification: CL-LEAN CLAY WITH SAND

-- SAMPLE INFORMATION --

Sample Weight (gm) =	50.0	Specific Gravity (Gs) =	2.7
Total Percent Fines =	79.80%	Test Sample Fraction Used - Passing # 40 Sieve	

Date	Time	Elapsed Time (min)	Temp (C)	Hydrometer Reading (Ra)	Temp Correction (Ct)	Corrected Reading (Rc)	% Finer	Corrected % Finer	Meniscus Correction (R)	L	L/t	Diameter. (mm)
7/27/94	10:00	0.25	20	46	0.0	40	79.2	81.0	47	8.751	35.00	0.0816
		0.5	20	44	0.0	38	75.2	76.9	45	9.079	18.16	0.0588
	10:01	1	20	43	0.0	37	73.3	74.9	44	9.243	9.24	0.0420
	10:02	2	20	42	0.0	36	71.3	72.9	43	9.407	4.70	0.0299
	10:04	4	20	40	0.0	34	67.3	68.8	41	9.735	2.43	0.0215
	10:08	8	20	38	0.0	32	63.4	64.8	39	10.06	1.26	0.0155
	10:15	15	20	36	0.0	30	59.4	60.7	37	10.39	0.69	0.0115
	10:30	30	20	35	0.0	29	57.4	58.7	36	10.56	0.35	0.0082
	11:00	60	20	33	0.0	27	53.5	54.7	34	10.88	0.18	0.0059
	12:00	120	20	30	0.0	24	47.5	48.6	31	11.38	0.09	0.0042
	14:00	240	20	27	0.0	21	41.6	42.5	28	11.87	0.05	0.0031
	18:00	480	20	25	0.0	19	37.6	38.5	26	12.2	0.03	0.0022
7/28/94	10:00	1440	20	22	0.0	16	31.7	32.4	23	12.69	0.01	0.0013
7/29/94	10:00	2880	20	20	0.0	14	27.7	28.3	21	14.00	0.00	0.0010

Correction for Gs = 0.99

Zero Correction = 6

Unit Weight of Soil Solids and Temperature Combination Constant (K) = 0.01380

Percent Finer Correction:

Interpolate Hydrometer Data to determine % Finer at 0.075mm (#200 sieve)

% Finer (From Hydrometer Analysis) at 0.075mm = 78.05%

Establish Correction Factor to Correlate % Passing #200 Sieve to Finer % in Hydrometer Analysis

% Finer Correction = 1.0225

NOTES:

Although the sample included all particles which passed the #40 sieve, the Corrected % Finer was computed to reflect all particles which passed the #200 sieve during the sieve analysis.

HYDRAULIC CONDUCTIVITY  
(FLEXIBLE-WALL PERMEAMETER)  
(ASTM D-5084)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Location:	DB-5
Project Number:	940387	Depth of Sample:	53-55' BGS
Task Number:	0004	Sample Source:	Shelby Tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/12/94
Personnel:	JAG	Report Date:	9/12/94

Soil Classification: CL-LEAN CLAY WITH SAND

--SAMPLE INFORMATION--

Soil Type:	CLAY	Permeameter #:	6
Height (cm):	5.3	Permeant:	.01 N CASO4
Diameter (cm):	7.2	Upper Burette Area:	2.075
Area (cm ^ 2):	40.7	Upper Burette Pressure (psi):	25.0
Volume (cm ^ 3):	215.8	Lower Burette Area (cm ^ 2):	2.083
Initial Weight (grams):	484.8	Lower Burette Pressure (psi):	28.0
Initial Moisture Content:	18.15%	Chamber Pressure (psi):	30.0
Final Weight (grams):	483.00	Pressure Gradient:	39.8
Final Moisture Content:	18.95%	alpha:	0.136
Specific Gravity:	2.70		

Elapsed Tim (min)	V (ml) up	V (ml) low	Head (cm)	Dt (min)	Dt (sec)	Ln (Ht/Ht)	Permeability (K at T)	Temp C	Permeability (K at T=20)
0	43.8	1.0	231.8	0	0	-	-	21.0	-
420	43.6	1.2	231.6	420	25200	8.3E-04	4.47E-09	21.0	4.36E-09
1380	43.0	2.0	230.9	960	57600	2.9E-03	6.85E-09	21.0	6.68E-09
1920	42.6	2.2	230.6	540	32400	1.3E-03	5.24E-09	21.0	5.11E-09
2880	42.0	3.0	230.0	960	57600	2.9E-03	6.88E-09	21.0	6.71E-09
4260	41.0	3.8	229.1	1380	82800	3.8E-03	6.18E-09	21.0	6.03E-09
4800	40.6	4.2	228.7	540	32400	1.7E-03	7.04E-09	21.0	6.86E-09
5700	40.0	5.0	228.1	900	54000	2.9E-03	7.40E-09	21.0	7.22E-09
6120	39.8	5.2	227.9	420	25200	8.4E-04	4.54E-09	21.0	4.43E-09
11460	36.2	8.6	224.5	5340	320400	1.5E-02	6.30E-09	21.0	6.15E-09
12900	35.0	9.6	223.4	1440	86400	4.7E-03	7.42E-09	21.0	7.24E-09
14340	34.0	10.6	222.5	1440	86400	4.3E-03	6.77E-09	21.0	6.61E-09
15840	33.0	11.6	221.5	1500	90000	4.3E-03	6.53E-09	21.0	6.37E-09

Average Stabilized Permeability, K(cm/sec) = 6.31E-09

Notes:

1. N.A. = Not available
2. - = Averaging ended

**SPECIFIC GRAVITY  
(ASTM D-854)**

Project Name: LAIDLAW WASTE SYSTEMS

Project Number: 940387 Task Number: 0004 Activity Number: -----

Date: 7/27/94 Personnel: JAG

Location of Test: DELL ENGINEERING, INC. Sample Source: SHELBY TUBE Sample Boring: DB-5

Soil Classification: CL - LEAN CLAY WITH SAND Depth of Sample: 53 - 55' BGS

TEST NUMBER:	1	2		
Volumetric Flask Number	2	2		
Volume of Flask	500.0	500.0		
Weight of Flask + Water Filled to Mark, $W_1$ (g)	677.6	677.6		
Weight of Flask + Soil + Water Filled to Mark, $W_2$ (g)	708.9	709.3		
Weight of Dry Soil, $W_3$ (g)	50.0	50.0		
Temperature of Test, $T_1$ °C	20.0	20.0		
$\bar{G}_s$ (at $T_1$ °C) = $\frac{W_3}{(W_1 + W_3) - W_2}$	2.67	2.73		
Temperature Correction Factor, K	1.0	1.0		
$G_s$ (at 20 °C) = $K \times \bar{G}_s$ (at $T$ °C)	2.67	2.73		



**ATTERBERG LIMITS DETERMINATION**  
(ASTM D4318-84)

Project Name: LAIDLAW WASTE SYSTEMS  
 Project Number: 940387  
 Task Number: 0004  
 Location of Test: Dell Engineering, Inc.  
 Personnel: JAG

Sample Boring: DB-7  
 Depth of Sample: 88-90'  
 Sample Source: SHELBY TUBE  
 Date Collected: 7/6/94  
 Date Analyzed: 7/27/94

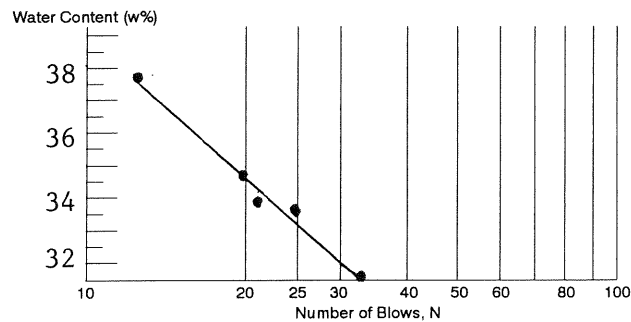
Soil Classification: CL-LEAN CLAY WITH SAND

**Liquid Limits Determination**

Can Number:	4	6	9	13	18	
Weight of Wet Soil + Can:	25.10	28.00	32.30	31.50	24.30	
Weight of Dry Soil + Can:	21.80	23.80	27.60	27.00	20.90	
Weight Of Can:	11.30	11.30	13.70	14.10	11.90	
Weight of Dry Soil:	10.50	12.50	13.90	12.90	9.00	
Weight of Moisture:	3.30	4.20	4.70	4.50	3.40	
Water Content, (w%):	31.43	33.60	33.81	34.88	37.78	
Number of Blows, (N):	33	25	22	20	13	

**Plastic Limits Determination**

Can Number:	1	7	12	15
Weight of Wet Soil + Can:	27.50	22.90	17.70	23.20
Weight of Dry Soil + Can:	25.60	21.60	16.80	21.80
Weight of Can:	14.30	14.00	11.50	13.90
Weight of Dry Soil:	11.30	7.60	5.30	7.90
Weight of Moisture:	1.90	1.30	0.90	1.40
Water Content, (w%=wp):	16.81	17.11	16.98	17.72
Average Water Content =	17.2%			



Liquid Limit = 33.4%  
 Plastic Limit = 17.2%  
 Plasticity Index = 16.2%

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring	DB-7
Project Number:	940387	Depth of Sample:	88-90' BGS
Task Number:	0004	Sample Source:	SHELBY TUBE
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	7/27/94
Personnel:	JAG		

Soil Classification                      CL-LEAN CLAY WITH SAND

LOSS BY WASHING

Pan Weight (grams) =	655.5	Weight of Soil Before Washing (grams) =	300.00
Pan and Dry Soil Weight (grams):	955.5	Weight of Soil After Washing (grams) =	79.20
		Difference (grams) =	220.80
		Percent Lost by Washing =	73.60

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	3.30	1.10	1.10	98.90
#10	5.50	1.83	2.93	97.07
#40	8.70	2.90	5.83	94.17
#100	36.50	12.17	18.00	82.00
#200	25.40	8.47	26.47	73.53
PAN	0.00	73.60	100.07	0.00
TOTAL	79.40	100.07	-	-

% Gravel =	1.10
% Coarse Sand =	1.83
% Medium Sand =	2.90
% Fine Sand =	20.63
% Silt or Clay =	73.60

NOTES

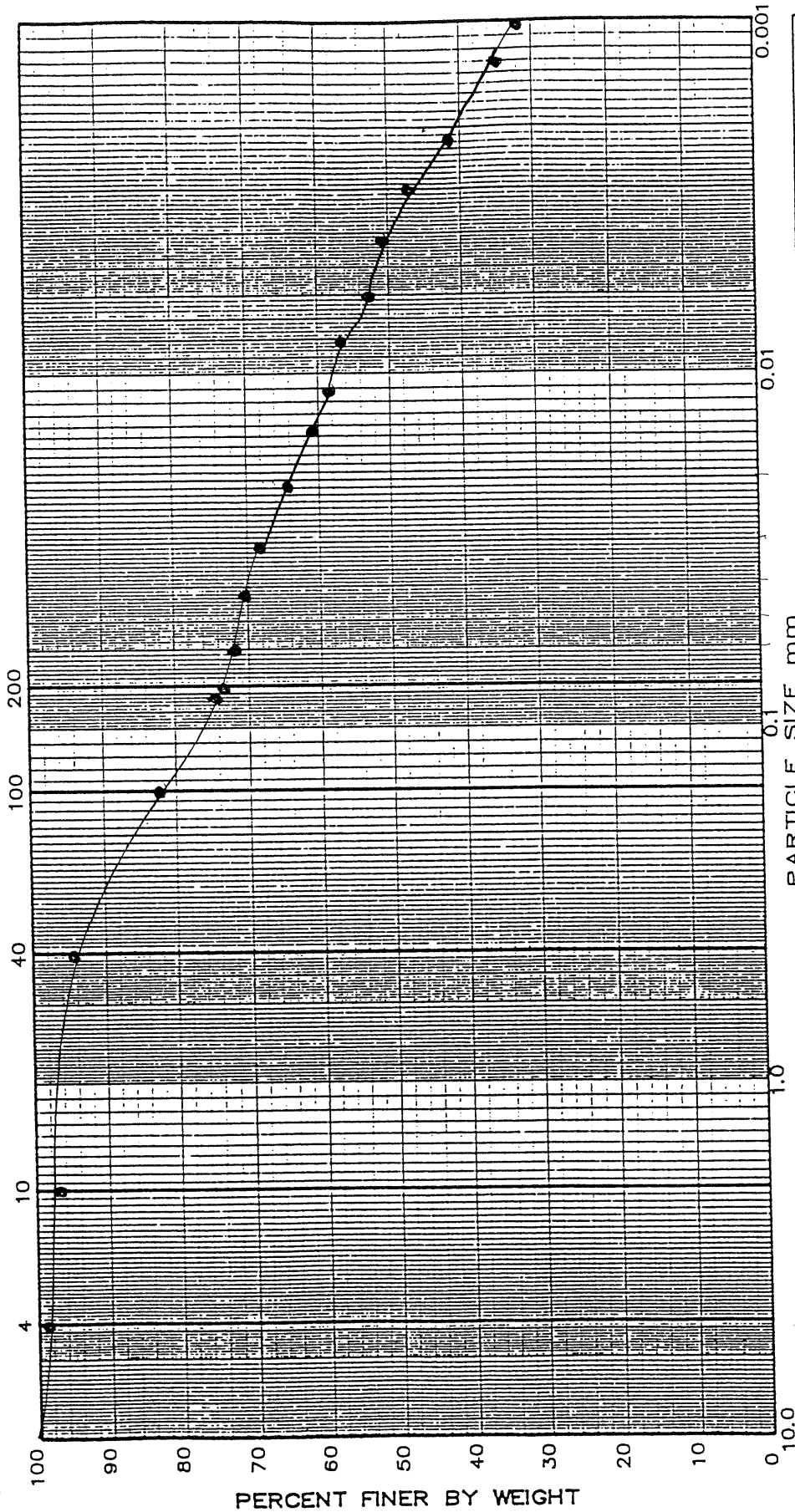
% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.

The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.

JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT OR CLAY
1.10	1.83	2.90	20.63	73.60
BORING NO.	SAMPLE NO.	DEPTH	ASTM CLASSIFICATION	SOIL DESCRIPTION
DB-7	--	88-90'	CL-LEAN CLAY WITH SAND	CLAY WITH SAND

DELL ENGINEERING, INC. PARTICLE SIZE DISTRIBUTION

Civil Engineering • Environmental Consulting  
3352 128th Avenue, Holland, Michigan 49424-9263

# HYDROMETER (ASTM D-422)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-7
Project Number:	940387	Depth of Sample:	88-90'
Task Number:	0004	Sample Source:	Shelby Tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/6/94
Personnel:	JAG	Date Analyzed:	7/27/94

Soil Classification: CL-LEAN CLAY WITH SAND

## -- SAMPLE INFORMATION --

Sample Weight (gm) =	50.0	Specific Gravity (Gs) =	2.67
Total Percent Fines =	73.60%	Test Sample Fraction Used - Passing # 40 Sieve	

Date	Time	Elapsed Time (min)	Temp (C)	Hydrometer Reading (Ra)	Temp Correction (Ct)	Corrected Reading (Rc)	% Finer	Corrected % Finer	Meniscus Correction (R)	L	L/t	Diameter. (mm)
7/27/94	10:00	0.25	20	44	0.0	38	75.7	74.3	45	9.079	36.32	0.0832
		0.5	20	43	0.0	37	73.7	72.3	44	9.243	18.49	0.0593
	10:01	1	20	42	0.0	36	71.7	70.4	43	9.407	9.41	0.0423
	10:02	2	20	41	0.0	35	69.7	68.4	42	9.571	4.79	0.0302
	10:04	4	20	39	0.0	33	65.7	64.5	40	9.899	2.47	0.0217
	10:08	8	20	37	0.0	31	61.8	60.6	38	10.23	1.28	0.0156
	10:15	15	20	36	0.0	30	59.8	58.6	37	10.39	0.69	0.0115
	10:30	30	20	35	0.0	29	57.8	56.7	36	10.56	0.35	0.0082
	11:00	60	20	33	0.0	27	53.8	52.8	34	10.88	0.18	0.0059
	12:00	120	20	32	0.0	26	51.8	50.8	33	11.05	0.09	0.0042
	14:00	240	20	30	0.0	24	47.8	46.9	31	11.38	0.05	0.0030
	18:00	480	20	27	0.0	21	41.8	41.0	28	11.87	0.02	0.0022
7/28/94	10:00	1440	20	24	0.0	18	35.9	35.2	25	12.36	0.01	0.0013
7/29/94	10:00	2880	20	22	0.0	16	31.9	31.3	23	14.00	0.00	0.0010

Correction for Gs = 1.00

Zero Correction = 6

Unit Weight of Soil Solids and Temperature Combination Constant (K) = 0.01380

Percent Finer Correction:

Interpolate Hydrometer Data to determine % Finer at 0.075mm (#200 sieve)

% Finer (From Hydrometer Analysis) at 0.075mm = 75.01%

Establish Correction Factor to Correlate % Passing #200 Sieve to Finer % in Hydrometer Analysis

% Finer Correction = 0.9812

## NOTES:

Although the sample included all particles which passed the #40 sieve, the Corrected % Finer was computed to reflect all particles which passed the #200 sieve during the sieve analysis.

HYDRAULIC CONDUCTIVITY  
(FLEXIBLE-WALL PERMEAMETER)  
(ASTM D-5084)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Location:	DB-7
Project Number:	940387	Depth of Sample:	88-90' BGS
Task Number:	0004	Sample Source:	Shelby Tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/6/94
Personnel:	JAG	Report Date:	8/19/94

Soil Classification: CL-LEAN CLAY WITH SAND

-- SAMPLE INFORMATION --

Soil Type:	CLAY	Permeameter #:	3
Height (cm):	5.3	Permeant:	.01 N CASO <sub>4</sub>
Diameter (cm):	7.2	Upper Burette Area:	2.033
Area (cm <sup>2</sup> ):	40.7	Upper Burette Pressure (psi):	25.0
Volume (cm <sup>3</sup> ):	215.8	Lower Burette Area (cm <sup>2</sup> ):	2.048
Initial Weight (grams):	488.7	Lower Burette Pressure (psi):	27.0
Initial Moisture Content:	12.50%	Chamber Pressure (psi):	30.0
Final Weight (grams):	486.10	Pressure Gradient:	26.6
Final Moisture Content:	13.90%	alpha:	0.133
Specific Gravity:	2.67		

Elapsed Time (min)	V (ml) up	V (ml) low	Head (cm)	Dt (min)	Dt (sec)	Ln (Ht/Ht)	Permeability (K at T)	Temp C	Permeability (K at T=20)
0	48.4	5.8	161.6	0	0	—	—	21.0	—
2820	40.8	15.0	153.4	2820	169200	5.2E-02	4.12E-08	21.0	4.02E-08
3360	39.6	16.2	152.2	540	32400	7.7E-03	3.17E-08	21.0	3.09E-08
4260	37.4	18.4	150.1	900	54000	1.4E-02	3.52E-08	21.0	3.43E-08
4620	36.6	19.2	149.3	360	21600	5.2E-03	3.23E-08	21.0	3.15E-08
4740	36.2	19.4	149.0	120	7200	2.0E-03	3.65E-08	21.0	3.56E-08
8580	27.8	28.0	140.7	3840	230400	5.8E-02	3.33E-08	21.0	3.25E-08
9120	26.8	29.0	139.7	540	32400	7.0E-03	2.88E-08	21.0	2.81E-08
10020	25.0	30.8	137.9	900	54000	1.3E-02	3.14E-08	21.0	3.06E-08
10320	24.2	31.6	137.1	300	18000	5.7E-03	4.22E-08	21.0	4.12E-08
12900	19.0	36.4	132.2	2580	154800	3.6E-02	3.13E-08	21.0	3.06E-08
14580	16.0	39.6	129.2	1680	100800	2.3E-02	3.07E-08	21.0	3.00E-08
18380	8.0	47.4	121.5	3800	228000	6.2E-02	3.61E-08	21.0	3.52E-08
0	43.2	7.2	158.4	0	0	—	—	21.0	—
2760	39.6	13.2	153.7	2760	165600	3.0E-02	2.42E-08	21.0	2.36E-08
5640	33.4	19.4	147.6	2880	172800	4.0E-02	3.11E-08	21.0	3.04E-08

Average Stabilized Permeability, K(cm/sec) = 3.25E-08

Notes:

1. N.A. = Not available
2. — = Averaging ended

**SPECIFIC GRAVITY  
(ASTM D-854)**

Project Name: LAIDLAW WASTE SYSTEMS

Project Number: 940387 Task Number: 0004 Activity Number: -----

Date: 7/27/94 Personnel: JAG

Location of Test: DELL ENGINEERING, INC. Sample Source: SHELBY TUBE Sample Boring: DB-7

Soil Classification: CL - LEAN CLAY WITH SAND Depth of Sample: 88 - 90' BGS

TEST NUMBER:	1	2		
Volumetric Flask Number	2	2		
Volume of Flask	500.0	500.0		
Weight of Flask + Water Filled to Mark, $W_1$ (g)	677.6	677.6		
Weight of Flask + Soil + Water Filled to Mark, $W_2$ (g)	708.6	709.1		
Weight of Dry Soil, $W_3$ (g)	50.0	50.0		
Temperature of Test, $T_1$ °C	20.0	20.0		
$G_s$ (at $T_1$ °C) = $\frac{W_3}{(W_1 + W_3) - W_2}$	2.63	2.70		
Temperature Correction Factor, K	1.0	1.0		
$G_s$ (at 20 °C) = $K \times G_s$ (at $T$ °C)	2.63	2.70		

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-11
Project Number:	940387	Depth of Sample:	102-104' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/24/94
Personnel:	JAG		

Soil Description: FINE SAND WITH CLAY

## LOSS BY WASHING

Pan Weight (grams) =	202.4	Weight of Soil Before Washing (grams) =	300.00
Pan and Dry Soil Weight (grams):	502.4	Weight of Soil After Washing (grams) =	279.50
		Difference (grams) =	20.50
		Percent Lost by Washing =	6.83

## Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	3.60	1.20	1.20	98.80
#10	1.70	0.57	1.77	98.23
#40	97.80	32.60	34.37	65.63
#100	164.60	54.87	89.23	10.77
#200	11.30	3.77	93.00	7.00
PAN	0.20	6.90	99.90	0.00
TOTAL	279.20	99.90	—	—

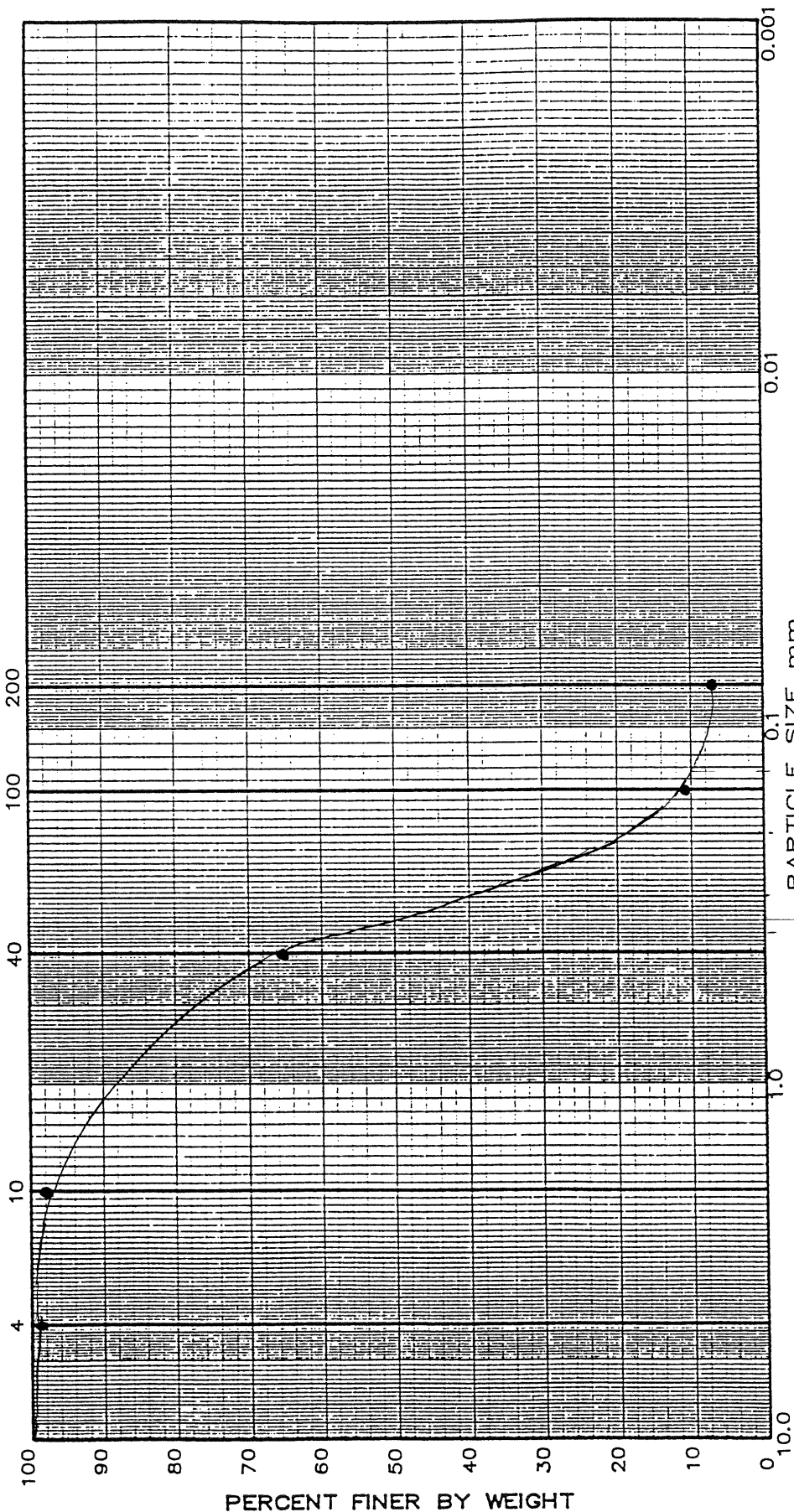
% Gravel =	1.20
% Coarse Sand =	0.57
% Medium Sand =	32.60
% Fine Sand =	58.63
% Silt or Clay =	6.90

## NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
 The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.  
 No definite classification can be made because there is insufficient material to run atterburg limits on the fines. Classification is either SP-SM or most likely SP-SC.

JOB NO. 940387  
DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT OR CLAY
1.20	0.57	32.60	58.63	6.90
BORING NO.	SAMPLE NO.	DEPTH	ASTM CLASSIFICATION	SOIL DESCRIPTION
DB-11	---	102-104'	---	FINE SAND WITH CLAY



SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-11
Project Number:	940387	Depth of Sample:	124-126' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/25/94
Personnel:	JAG		

Soil Description: CLAYEY SAND

LOSS BY WASHING

Pan Weight (grams) =	202.0	Weight of Soil Before Washing (grams) =	250.00
Pan and Dry Soil Weight (grams):	452.0	Weight of Soil After Washing (grams) =	146.50
		Difference (grams) =	103.50
		Percent Lost by Washing =	41.40

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	15.20	6.08	6.08	93.92
#10	9.90	3.96	10.04	89.96
#40	19.80	7.92	17.96	82.04
#100	61.90	24.76	42.72	57.28
#200	38.10	15.24	57.96	42.04
PAN	1.20	41.88	99.84	0.00
TOTAL	146.10	99.84	—	—

% Gravel =	6.08
% Coarse Sand =	3.96
% Medium Sand =	7.92
% Fine Sand =	40.00
% Silt or Clay =	41.88

NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.

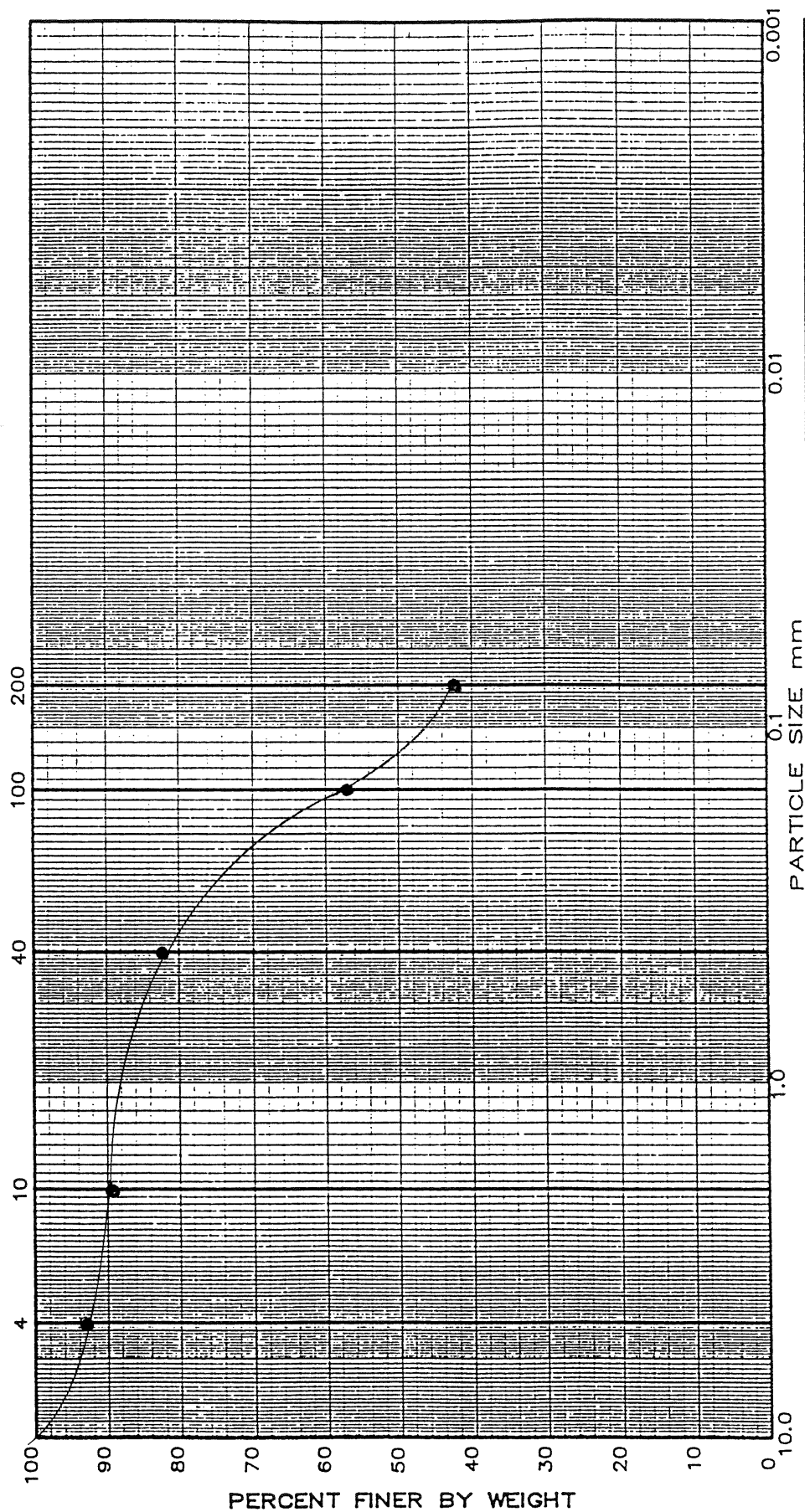
The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.

No definite classification can be made because there is insufficient material to run atterburg limits on the fines. Classification is either SM or SC—SM or most likely SC.

JOB NO. 940387.

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT OR CLAY
6.08	3.96	7.92	40.00	41.88
BORING NO. DB-11		SAMPLE NO. --	DEPTH 124-126'	ASTM CLASSIFICATION ---
		SOIL DESCRIPTION CLAYEY SAND		

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SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-11
Project Number:	940387	Depth of Sample:	160-161' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/26/94
Personnel:	JAG		

Soil Description: CLAYEY SAND

LOSS BY WASHING

Pan Weight (grams) =	100.0	Weight of Soil Before Washing (grams) =	265.00
Pan and Dry Soil Weight (grams):	365.0	Weight of Soil After Washing (grams) =	163.00
		Difference (grams) =	102.00
		Percent Lost by Washing =	38.49

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	30.30	11.43	11.43	88.57
#10	11.10	4.19	15.62	84.38
#40	18.90	7.13	22.75	77.25
#100	77.80	29.36	52.11	47.89
#200	24.10	9.09	61.21	38.79
PAN	0.00	38.49	99.70	0.00
TOTAL	162.20	99.70	-	-

% Gravel =	11.43
% Coarse Sand =	4.19
% Medium Sand =	7.13
% Fine Sand =	38.45
% Silt or Clay =	38.49

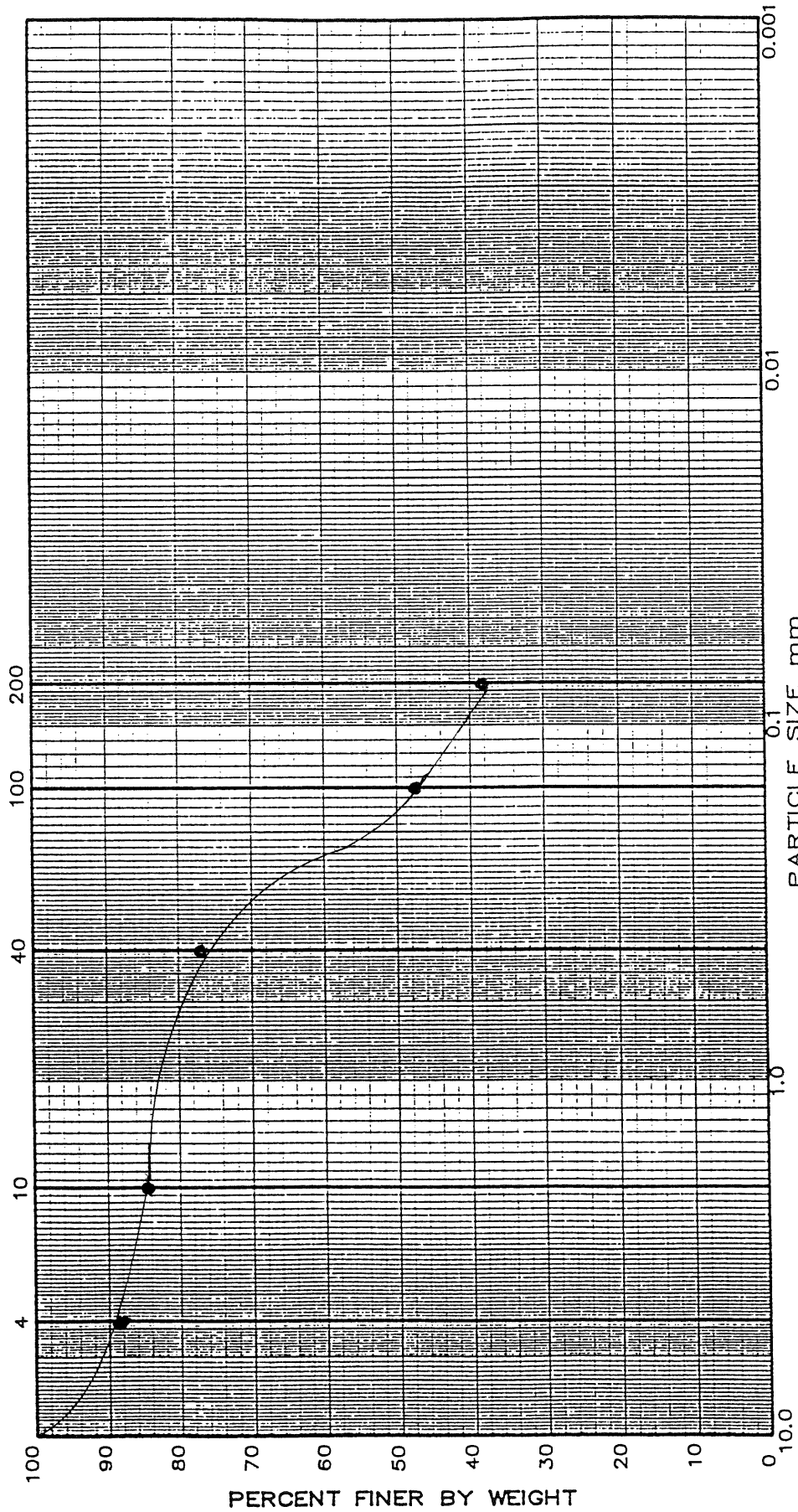
NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
 The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.  
 No definite classification can be made because there is insufficient material to run atterburg limits on the fines. Classification is either SM or SC-SM or most likely SC.

JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL		MEDIUM SAND		FINE SAND		SILT OR CLAY	
11.43	4.19	7.13	38.45	38.49	38.49	SOIL DESCRIPTION	
BORING NO.		SAMPLE NO.		DEPTH		ASTM CLASSIFICATION	
DB-11		---		160-161'		---	
						CLAYEY SAND	



ATTERBERG LIMITS DETERMINATION  
(ASTM D4318-84)

Project Name: LAIDLAW WASTE SYSTEMS  
 Project Number: 940387  
 Task Number: 0004  
 Location of Test: Dell Engineering, Inc.  
 Personnel: JAG

Sample Boring: DB-13  
 Depth of Sample: 60-62'  
 Sample Source: SHELBY TUBE  
 Date Collected: 7/21/94  
 Date Analyzed: 8/24/94

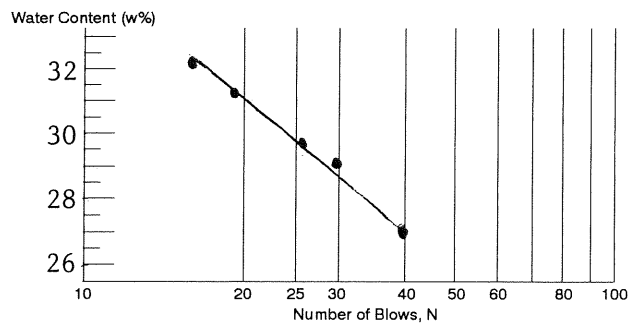
Soil Classification: CL-SANDY LEAN CLAY

Liquid Limits Determination

Can Number:	1	3	4	5	8
Weight of Wet Soil + Can:	33.00	34.10	32.80	35.50	33.00
Weight of Dry Soil + Can:	29.10	29.60	27.90	30.40	27.80
Weight Of Can:	14.60	14.10	11.30	14.00	11.60
Weight of Dry Soil:	14.50	15.50	16.60	16.40	16.20
Weight of Moisture:	3.90	4.50	4.90	5.10	5.20
Water Content, (w%):	26.90	29.03	29.52	31.10	32.10
Number of Blows, (N):	40	30	26	19	16

Plastic Limits Determination

Can Number:	12	13	17
Weight of Wet Soil + Can:	22.10	20.30	21.80
Weight of Dry Soil + Can:	20.70	19.50	20.70
Weight of Can:	11.70	14.20	14.20
Weight of Dry Soil:	9.00	5.30	6.50
Weight of Moisture:	1.40	0.80	1.10
Water Content, (w%=wp):	15.56	15.09	16.92
Average Water Content =	15.9%		



Liquid Limit = 29.8%  
 Plastic Limit = 15.9%  
 Plasticity Index = 13.9%

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAILAW WASTE SYSTEMS	Sample Boring:	DB-13
Project Number:	940387	Depth of Sample:	60-62' BGS
Task Number:	0004	Sample Source:	SHELBY TUBE
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/24/94
Personnel:	JAG		

Soil Classification: CL-SANDY LEAN CLAY

LOSS BY WASHING

Pan Weight (grams) =	306.5	Weight of Soil Before Washing (grams) =	300.00
Pan and Dry Soil Weight (grams):	606.5	Weight of Soil After Washing (grams) =	114.10
		Difference (grams) =	185.90
		Percent Lost by Washing =	61.97

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	12.60	4.20	4.20	95.80
#10	5.80	1.93	6.13	93.87
#40	11.50	3.83	9.97	90.03
#100	50.30	16.77	26.73	73.27
#200	33.70	11.23	37.97	62.03
PAN	0.20	62.03	100.00	0.00
TOTAL	114.10	100.00	—	—

% Gravel =	4.20
% Coarse Sand =	1.93
% Medium Sand =	3.83
% Fine Sand =	28.00
% Silt or Clay =	62.03

NOTES

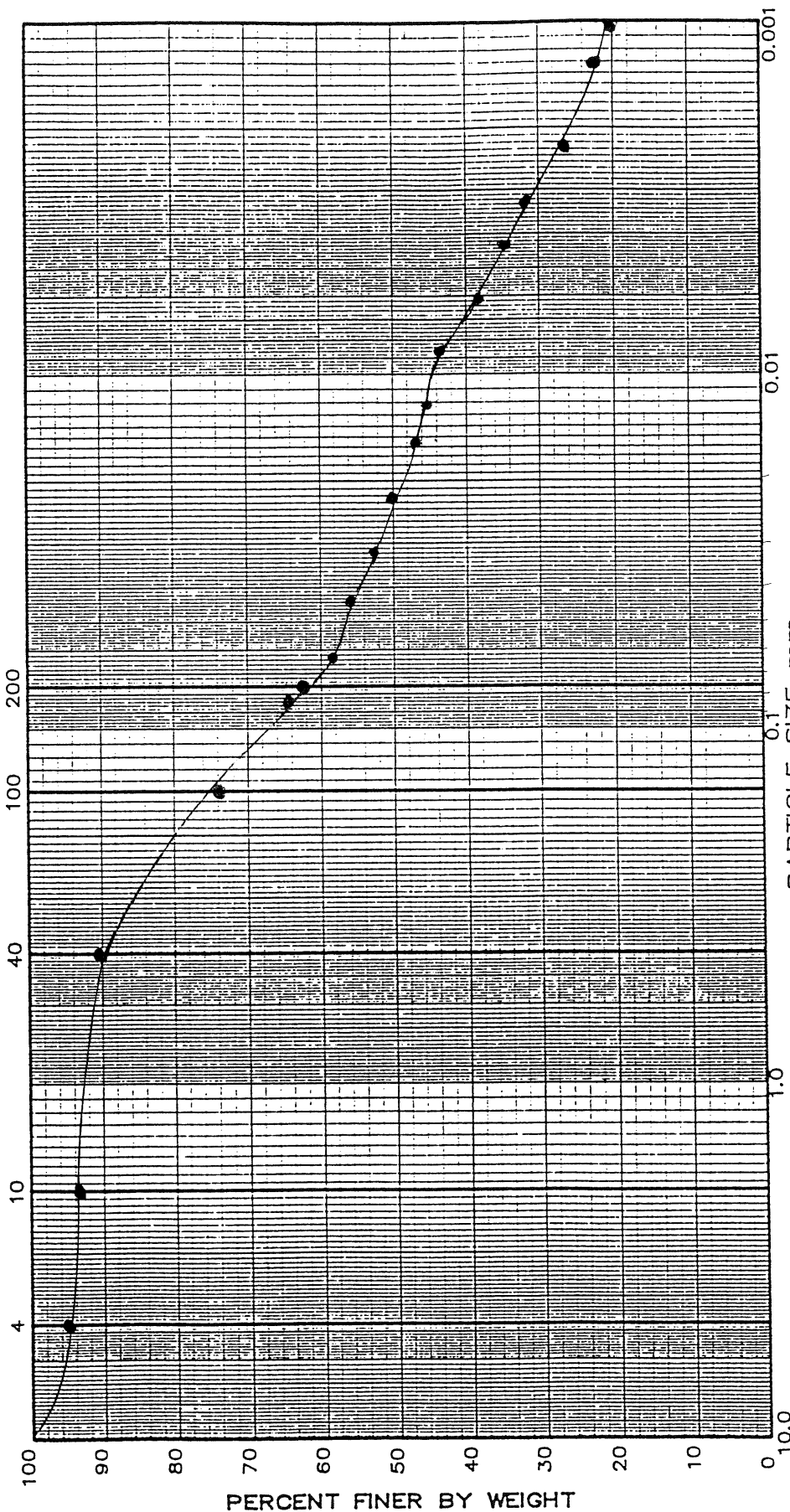
% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.

The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.

JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL		COARSE SAND		MEDIUM SAND		FINE SAND		SILT OR CLAY	
4.20		1.93		3.83		28.00		62.03	
BORING NO.		SAMPLE NO.		DEPTH		ASTM CLASSIFICATION		SOIL DESCRIPTION	
DB-13		---		60-62'		CL-SANDY LEAN CLAY		CLAY WITH SAND	

DELL ENGINEERING, INC. Civil Engineering • Environmental Consulting  
3352 128th Avenue, Holland, Michigan 49424-9263



# HYDROMETER (ASTM D-422)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-13
Project Number:	940387	Depth of Sample:	60-62'
Task Number:	0004	Sample Source:	shelby tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/21/94
Personnel:	JAG	Date Analyzed:	8/30/94

Soil Classification: CL-SANDY LEAN CLAY

## -- SAMPLE INFORMATION --

Sample Weight (gm) =	50.0	Specific Gravity (Gs) =	2.71
Total Percent Fines =	62.03%	Test Sample Fraction Used - Passing # 40 Sieve	

Date	Time	Elapsed Time (min)	Temp (C)	Hydrometer Reading (Ra)	Temp Correction (Ct)	Corrected Reading (Rc)	% Finer	Corrected % Finer	Meniscus Correction (R)	L	L/t	Diameter. (mm)
8/30/94	10:00	0.25	20	42	0.0	36	71.1	65.1	43	9.407	37.63	0.0847
		0.5	20	38	0.0	32	63.2	57.9	39	10.06	20.13	0.0619
	10:01	1	20	37	0.0	31	61.3	56.1	38	10.23	10.23	0.0441
	10:02	2	20	35	0.0	29	57.3	52.4	36	10.56	5.28	0.0317
	10:04	4	20	34	0.0	28	55.3	50.6	35	10.72	2.68	0.0226
	10:08	8	20	32	0.0	26	51.4	47.0	33	11.05	1.38	0.0162
	10:15	15	20	31	0.0	25	49.4	45.2	32	11.21	0.75	0.0119
	10:30	30	20	29	0.0	23	45.4	41.6	30	11.54	0.38	0.0086
	11:00	60	20	27	0.0	21	41.5	38.0	28	11.87	0.20	0.0061
	12:00	120	20	25	0.0	19	37.5	34.4	26	12.2	0.10	0.0044
	14:00	240	20	23	0.0	17	33.6	30.7	24	12.52	0.05	0.0032
	18:00	480	20	21	0.0	15	29.6	27.1	22	12.85	0.03	0.0023
8/31/94	10:00	1440	20	19	0.0	13	25.7	23.5	20	13.18	0.01	0.0013
9/1/94	10:00	2880	20	17	0.0	11	21.7	19.9	18	14.00	0.00	0.0010

Correction for Gs = 0.99

Zero Correction = 6

Unit Weight of Soil Solids and Temperature Combination Constant (K) = 0.01380

Percent Finer Correction:

Interpolate Hydrometer Data to determine % Finer at 0.075mm (#200 sieve)

% Finer (From Hydrometer Analysis) at 0.075mm = 67.78%

Establish Correction Factor to Correlate % Passing #200 Sieve to Finer % in Hydrometer Analysis

% Finer Correction = 0.9151

### NOTES:

Although the sample included all particles which passed the #40 sieve, the Corrected % Finer was computed to reflect all particles which passed the #200 sieve during the sieve analysis.



HYDRAULIC CONDUCTIVITY  
(FLEXIBLE–WALL PERMEAMETER)  
(ASTM D–5084)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Location:	DB–13
Project Number:	940387	Depth of Sample:	60–62' BGS
Task Number:	0004	Sample Source:	Shelby Tube
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/21/94
Personnel:	JAG	Report Date:	9/12/94

Soil Classification: CL–SANDY LEAN CLAY

--SAMPLE INFORMATION--

Soil Type:	CLAY	Permeameter #:	5
Height (cm):	5.3	Permeant:	.01 N CASO4
Diameter (cm):	7.2	Upper Burette Area:	1.976
Area (cm ^ 2):	40.7	Upper Burette Pressure (psi):	25.0
Volume (cm ^ 3):	215.8	Lower Burette Area (cm ^ 2):	1.976
Initial Weight (grams):	500.8	Lower Burette Pressure (psi):	28.0
Initial Moisture Content:	11.89%	Chamber Pressure (psi):	30.0
Final Weight (grams):	499.50	Pressure Gradient:	39.8
Final Moisture Content:	13.94%	alpha:	0.129
Specific Gravity:	2.71		

Elapsed Tim (min)	V (ml) up	V (ml) low	Head (cm)	Dt (min)	Dt (sec)	Ln (Ht/Ht)	Permeability (K at T)	Temp C	Permeability (K at T=20)
0	46.4	6.0	231.7	0	0	–	–	21.0	–
420	46.2	6.8	231.2	420	25200	2.2E–03	1.12E–08	21.0	1.09E–08
1380	45.4	8.0	230.2	960	57600	4.4E–03	9.80E–09	21.0	9.56E–09
1920	45.0	8.4	229.8	540	32400	1.8E–03	6.99E–09	21.0	6.82E–09
2880	44.6	9.0	229.3	960	57600	2.2E–03	4.92E–09	21.0	4.80E–09
4260	43.8	10.0	228.4	1380	82800	4.0E–03	6.18E–09	21.0	6.03E–09
4800	43.6	10.2	228.2	540	32400	8.9E–04	3.52E–09	21.0	3.43E–09
5700	43.2	10.6	227.8	900	54000	1.8E–03	4.23E–09	21.0	4.13E–09
6120	43.0	10.8	227.6	420	25200	8.9E–04	4.54E–09	21.0	4.43E–09
11460	41.0	12.8	225.5	5340	320400	8.9E–03	3.59E–09	21.0	3.50E–09
12900	40.4	13.2	225.0	1440	86400	2.2E–03	3.34E–09	21.0	3.26E–09
14340	40.0	13.8	224.5	1440	86400	2.3E–03	3.35E–09	21.0	3.27E–09
15840	39.2	14.6	223.7	1500	90000	3.6E–03	5.16E–09	21.0	5.04E–09

Average Stabilized Permeability, K(cm/sec) = 4.21E–09

Notes:

1. N.A. = Not available
2. – = Averaging ended

**SPECIFIC GRAVITY  
(ASTM D-854)**

Project Name: LIDLAW WASTE SYSTEMSProject Number: 940387 Task Number: 0004 Activity Number: \_\_\_\_\_Date: 8/24/94 Personnel: JAGLocation of Test: DELL ENGINEERING, INC. Sample Source: SHELBY TUBE Sample Boring: DB-13Soil Classification: CL-SANDY LEAN CLAY Depth of Sample: 60-62'

TEST NUMBER:	1	2		
Volumetric Flask Number	2	2		
Volume of Flask	500.0	500.0		
Weight of Flask + Water Filled to Mark, $W_1$ (g)	677.6	677.6		
Weight of Flask + Soil + Water Filled to Mark, $W_2$ (g)	709.2	709.1		
Weight of Dry Soil, $W_3$ (g)	50.0	50.0		
Temperature of Test, $T_1$ °C	20.0	20.0		
$G_s$ (at $T_1$ °C) = $\frac{W_3}{(W_1 + W_3) - W_2}$	2.72	2.70		
Temperature Correction Factor, K	1.0	1.0		
$G_s$ (at 20 °C) = $K \times G_s$ (at $T$ °C)	2.70	2.70		

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Number	DB-17
Project Number:	940387	Depth of Sample:	149-151' BGS
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	7/29/94
Personnel:	JAG		

Soil Description: SAND WITH CLAY

LOSS BY WASHING

Pan Weight (grams) =	1010.0	Weight of Soil Before Washing (grams) =	219.10
Pan and Dry Soil Weight (grams):	1229.1	Weight of Soil After Washing (grams) =	200.80
		Difference (grams) =	18.30
		Percent Lost by Washing =	8.35

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	5.10	2.33	2.33	97.67
#10	11.30	5.16	7.49	92.51
#40	85.90	39.21	46.69	53.31
#100	81.50	37.20	83.89	16.11
#200	16.60	7.58	91.47	8.53
PAN	0.00	8.35	99.82	0.00
TOTAL	200.40	99.82	-	-

% Gravel =	2.33
% Coarse Sand =	5.16
% Medium Sand =	39.21
% Fine Sand =	44.77
% Silt or Clay =	8.35

NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.

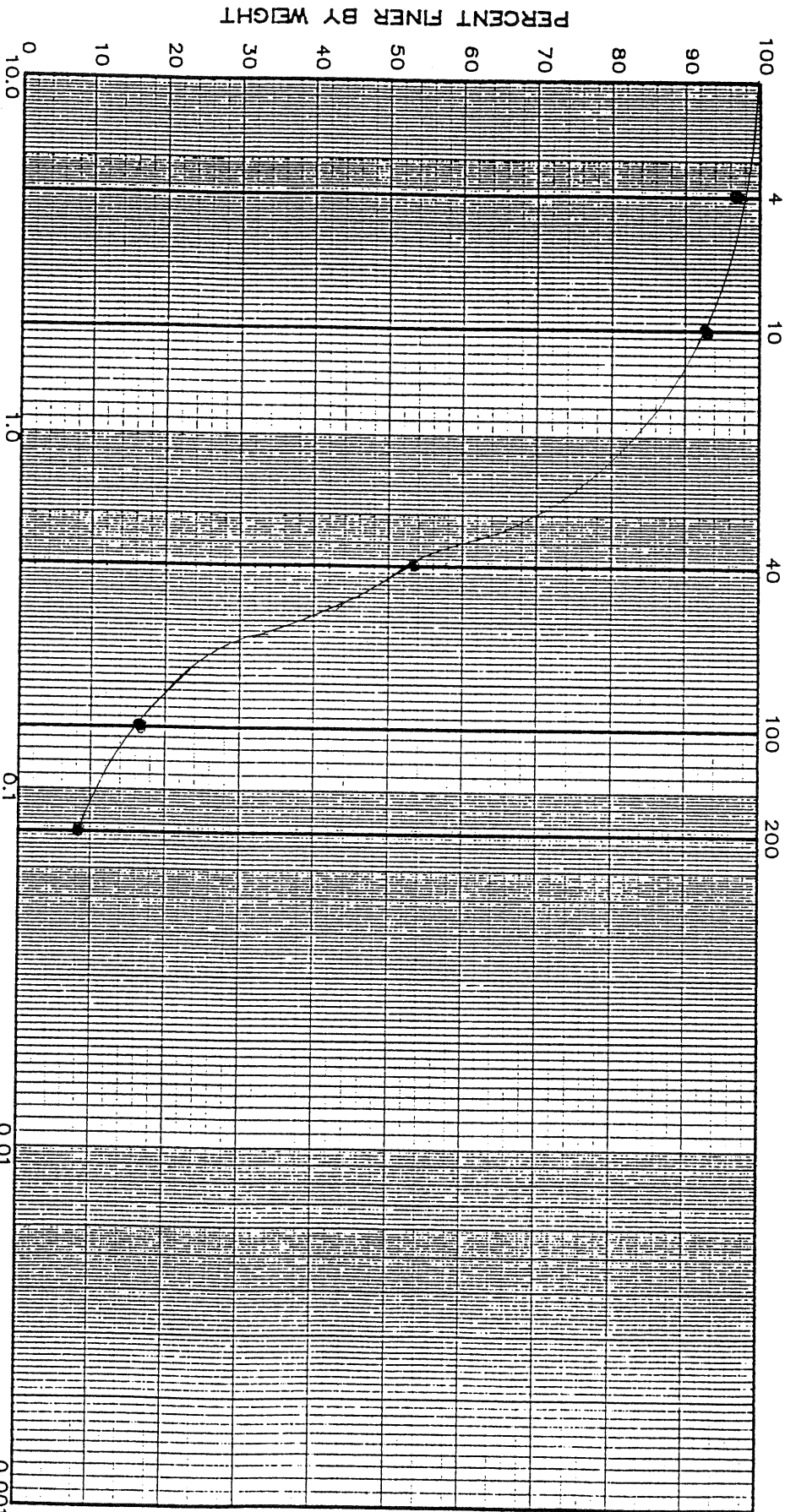
The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.

No classification can be made due to the lack of material to run atterburg limits on the fines.

U.S. STANDARD SIEVE SIZE

JOB NO. 940387

DATE 9/1/94



GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT OR CLAY
2.33	5.16	39.21	44.77	8.35
BORING NO.	SAMPLE NO.	DEPTH	ASTM CLASSIFICATION	SOIL DESCRIPTION
DB-17	--	149-151'	---	SAND WITH CLAY



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# ATTERBERG LIMITS DETERMINATION (ASTM D4318-84)

Project Name: LAIDLAW WASTE SYSTEMS  
 Project Number: 940387  
 Task Number: 0004  
 Location of Test: Dell Engineering, Inc.  
 Personnel: JAG

Sample Boring: DB-17  
 Depth of Sample: 169-171', 174-176', 179-181'  
 Sample Source: JAR  
 Date Collected: 7/27/94  
 Date Analyzed: 8/3/94

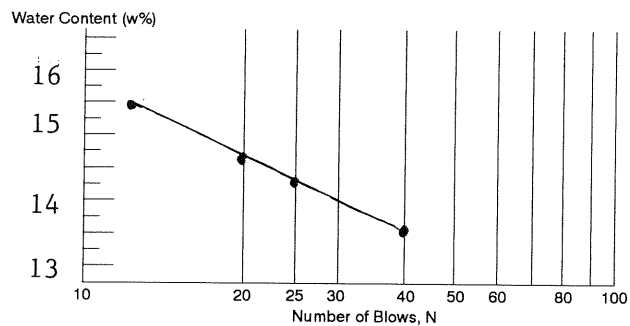
Soil Classification: SC-CLAYEY SAND

## Liquid Limits Determination

Can Number:	2	3	8	11		
Weight of Wet Soil + Can:	33.80	40.50	36.50	43.10		
Weight of Dry Soil + Can:	31.20	37.20	33.30	39.20		
Weight Of Can:	12.00	14.10	11.50	14.00		
Weight of Dry Soil:	19.20	23.10	21.80	25.20		
Weight of Moisture:	2.60	3.30	3.20	3.90		
Water Content, (w%):	13.54	14.29	14.68	15.48		
Number of Blows, (N):	40	25	20	13		

## Plastic Limits Determination

Can Number:	5	17	14	
Weight of Wet Soil + Can:	30.30	25.90	21.50	
Weight of Dry Soil + Can:	28.70	24.70	20.50	
Weight of Can:	14.10	14.20	11.60	
Weight of Dry Soil:	14.60	10.50	8.90	
Weight of Moisture:	1.60	1.20	1.00	
Water Content, (w% = wp):	10.96	11.43	11.24	
Average Water Content =	11.2%			



Liquid Limit = 14.4%  
 Plastic Limit = 11.2%  
 Plasticity Index = 3.2%

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name:	LAILAW WASTE SYSTEMS	Sample Boring	DB-17
Project Number:	940387	Depth of Sample:	169-171', 174-176', 179-181'
Task Number:	0004	Sample Source:	JAR
Location of Test:	Dell Engineering, Inc.	Date Analyzed:	8/5/94
Personnel:	JAG		
Soil Classification	SC-CLAYEY SAND		

LOSS BY WASHING

Pan Weight (grams) =	602.2	Weight of Soil Before Washing (grams) =	300.00
Pan and Dry Soil Weight (grams):	902.2	Weight of Soil After Washing (grams) =	191.00
		Difference (grams) =	109.00
		Percent Lost by Washing =	36.33

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	2.60	0.87	0.87	99.13
#10	4.00	1.33	2.20	97.80
#40	26.90	8.97	11.17	88.83
#100	116.50	38.83	50.00	50.00
#200	38.70	12.90	62.90	37.10
PAN	1.90	36.97	99.87	0.00
TOTAL	190.60	99.87	-	-

% Gravel =	0.87
% Coarse Sand =	1.33
% Medium Sand =	8.97
% Fine Sand =	51.73
% Silt or Clay =	36.97

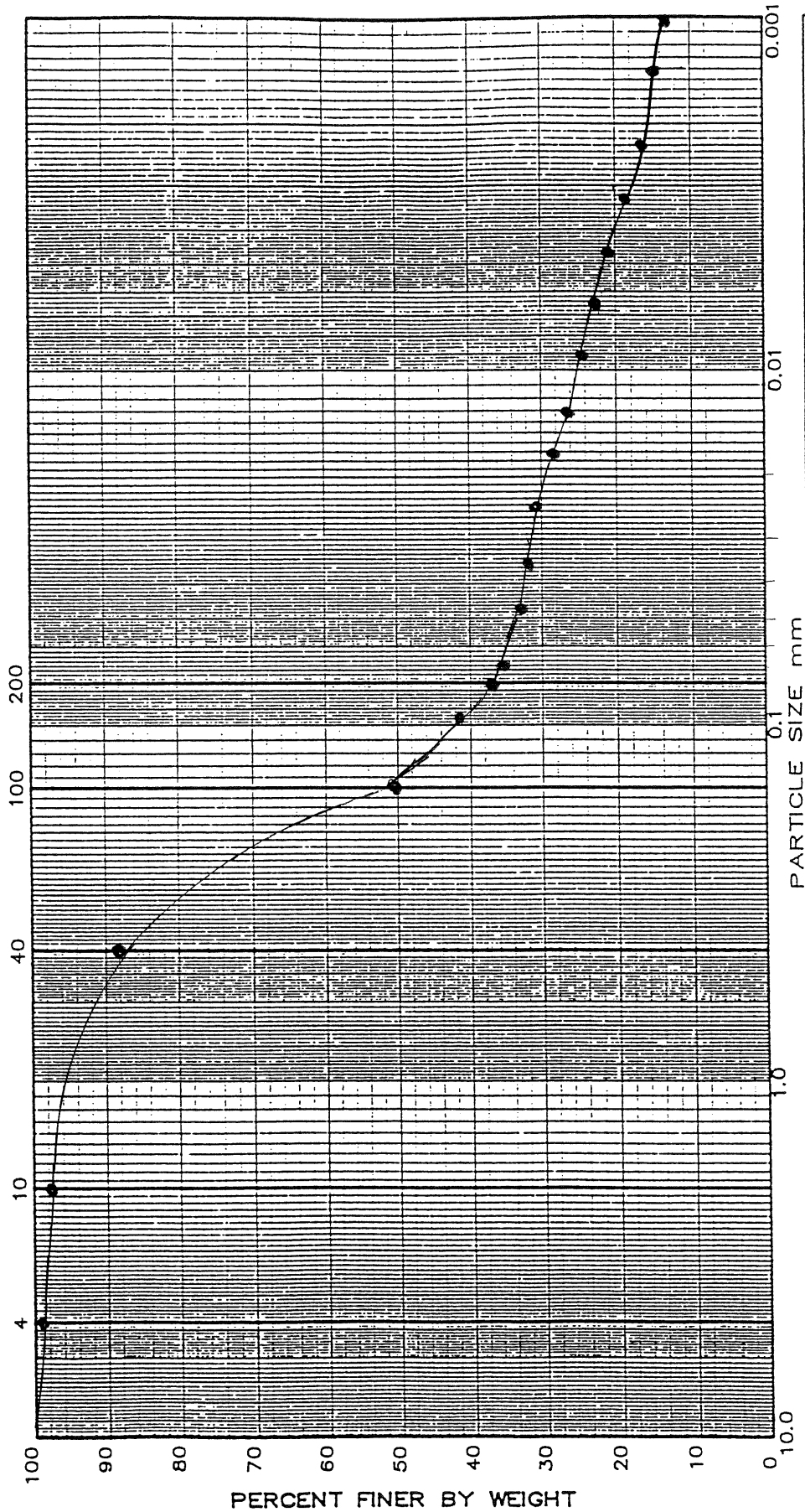
NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.

JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL		COARSE SAND		MEDIUM SAND		FINE SAND		SILT OR CLAY	
0.87		1.33		8.97		51.73		36.97	
BORING NO.		SAMPLE NO.		DEPTH		ASTM CLASSIFICATION		SOIL DESCRIPTION	
DB-17		--		169-171, 174-176, 179-181		SC-CLAYEY SAND		SAND WITH CLAY	

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# HYDROMETER (ASTM D-422)

Project Name:	LAIDLAW WASTE SYSTEMS	Sample Boring:	DB-17
Project Number:	940387	Depth of Sample:	169-171, 174-176, 179-181'
Task Number:	0004	Sample Source:	jar
Location of Test:	Dell Engineering, Inc.	Date Collected:	7/27/94
Personnel:	JAG	Date Analyzed:	8/16/94

Soil Classification: SC-CLAYEY SAND

## -- SAMPLE INFORMATION --

Sample Weight (gm) =	50.0	Specific Gravity (Gs) =	2.71
Total Percent Fines =	36.97%	Test Sample Fraction Used -	Passing # 40 Sieve

Date	Time	Elapsed Time (min)	Temp (C)	Hydrometer Reading (Ra)	Temp Correction (Ct)	Corrected Reading (Rc)	% Finer	Corrected % Finer	Meniscus Correction (R)	L	L/t	Diameter. (mm)
8/16/94	10:00	0.25	20	27	0.0	21	41.5	39.8	28	11.87	47.47	0.0951
		0.5	20	25	0.0	19	37.5	36.0	26	12.2	24.39	0.0682
	10:01	1	20	24	0.0	18	35.6	34.1	25	12.36	12.36	0.0485
	10:02	2	20	23	0.0	17	33.6	32.2	24	12.52	6.26	0.0345
	10:04	4	20	22	0.0	16	31.6	30.3	23	12.69	3.17	0.0246
	10:08	8	20	21	0.0	15	29.6	28.4	22	12.85	1.61	0.0175
	10:15	15	20	20	0.0	14	27.7	26.5	21	13.02	0.87	0.0129
	10:30	30	20	19	0.0	13	25.7	24.6	20	13.18	0.44	0.0091
	11:00	60	20	18	0.0	12	23.7	22.7	19	13.34	0.22	0.0065
	12:00	120	20	17	0.0	11	21.7	20.8	18	13.51	0.11	0.0046
	14:00	240	20	16	0.0	10	19.8	19.0	17	13.67	0.06	0.0033
	18:00	480	20	15	0.0	9	17.8	17.1	16	13.84	0.03	0.0023
8/17/94	10:00	1440	20	14	0.0	8	15.8	15.2	15	14	0.01	0.0014
8/18/94	10:00	2880	20	13	0.0	7	13.8	13.3	14	14.00	0.00	0.0010

Correction for Gs = 0.99

Zero Correction = 6

Unit Weight of Soil Solids and Temperature Combination Constant (K) = 0.01380

Percent Finer Correction:

Interpolate Hydrometer Data to determine % Finer at 0.075mm (#200 sieve)

% Finer (From Hydrometer Analysis) at 0.075mm = 38.55%

Establish Correction Factor to Correlate % Passing #200 Sieve to Finer % in Hydrometer Analysis

% Finer Correction = 0.9590

### NOTES:

Although the sample included all particles which passed the #40 sieve, the Corrected % Finer was computed to reflect all particles which passed the #200 sieve during the sieve analysis.



# **SPECIFIC GRAVITY** **(ASTM D-854)**

Project Name: LAIDLAW WASTE SYSTEMS

Project Number: 940387 Task Number: 0004 Activity Number: -----

Date: 8/5/94 Personnel: JAG

Location of Test: DELL ENGINEERING, INC. Sample Source: JAR Sample Boring: DB-17

Soil Classification: SC - CLAYEY SAND Depth of Sample: 169-171', 174-176', 179-181'

TEST NUMBER:				
Volumetric Flask Number	2	2		
Volume of Flask	500.0	500.0		
Weight of Flask + Water Filled to Mark, W <sub>1</sub> (g)	677.6	677.6		
Weight of Flask + Soil + Water Filled to Mark, W <sub>2</sub> (g)	709.1	709.2		
Weight of Dry Soil, W <sub>3</sub> (g)	50.0	50.0		
Temperature of Test, T <sub>1</sub> °C	20.0	20.0		
$G_s \text{ (at } T_1 \text{ °C)} = \frac{W_3}{(W_1 + W_3) - W_2}$	2.70	2.72		
Temperature Correction Factor, K	1.0	1.0		
$G_s \text{ (at } 20 \text{ °C)} = K \times G_s \text{ (at } T \text{ °C)}$	2.70	2.72		

# ATTERBERG LIMITS DETERMINATION (ASTM D4318-84)

Project Name: LAIDLAW WASTE SYSTEMS  
 Project Number: 940387  
 Task Number: 0004  
 Location of Test: Dell Engineering, Inc.  
 Personnel: JAG

Sample Boring: DB-5  
 Depth of Sample: 53-55'  
 Sample Source: SHELBY TUBE  
 Date Collected: 7/12/94  
 Date Analyzed: 7/26/94

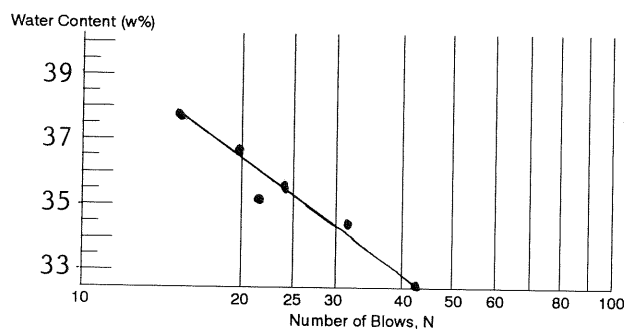
Soil Classification: CL-LEAN CLAY WITH SAND

## Liquid Limits Determination

Can Number:	4	6	9	13	25	18
Weight of Wet Soil + Can:	26.10	26.40	28.00	31.30	28.20	26.50
Weight of Dry Soil + Can:	22.30	22.70	24.30	26.80	24.00	22.50
Weight Of Can:	11.30	11.30	13.70	14.10	12.50	11.90
Weight of Dry Soil:	11.00	11.40	10.60	12.70	11.50	10.60
Weight of Moisture:	3.80	3.70	3.70	4.50	4.20	4.00
Water Content, (w%):	34.55	32.46	34.91	35.43	36.52	37.73
Number of Blows, (N):	33	43	22	24	20	16

## Plastic Limits Determination

Can Number:	1	7	12	15
Weight of Wet Soil + Can:	27.50	26.90	29.00	26.00
Weight of Dry Soil + Can:	25.50	25.00	26.30	24.20
Weight of Can:	14.30	14.00	11.50	13.90
Weight of Dry Soil:	11.20	11.00	14.80	10.30
Weight of Moisture:	2.00	1.90	2.70	1.80
Water Content, (w%=wp):	17.86	17.27	18.24	17.48
Average Water Content =	17.7%			



Liquid Limit = 35.5%  
 Plastic Limit = 17.7%  
 Plasticity Index = 17.8%

DELL ENGINEERING, INC.

SIEVE ANALYSIS  
(ASTM D-2487)

Project Name: LAIDLAW WASTE SYSTEMS Sample Boring DB-5  
Project Number: 940387 Depth of Sample: 53-55' BGS  
Task Number: 0004 Sample Source: SHELBY TUBE  
Location of Test: Dell Engineering, Inc. Date Analyzed: 7/27/94  
Personnel: JAG

Soil Classification CL-LEAN CLAY WITH SAND

LOSS BY WASHING

Pan Weight (grams) = 655.5 Weight of Soil Before Washing (grams) = 200.00  
Pan and Dry Soil Weight (grams): 855.5 Weight of Soil After Washing (grams) = 40.40  
Difference (grams) = 159.60  
Percent Lost by Washing = 79.80

Sieve Analysis

Sieve Size	Weight Retained	% Retained	Cumulative % Retained	% Passing
#3/4	0.0	0.0	0.0	100.0
#4	2.00	1.00	1.00	99.00
#10	2.70	1.35	2.35	97.65
#40	4.70	2.35	4.70	95.30
#100	19.40	9.70	14.40	85.60
#200	11.60	5.80	20.20	79.80
PAN	0.00	79.80	100.00	0.00
TOTAL	40.40	100.00	-	-

% Gravel = 1.00  
% Coarse Sand = 1.35  
% Medium Sand = 2.35  
% Fine Sand = 15.50  
% Silt or Clay = 79.80

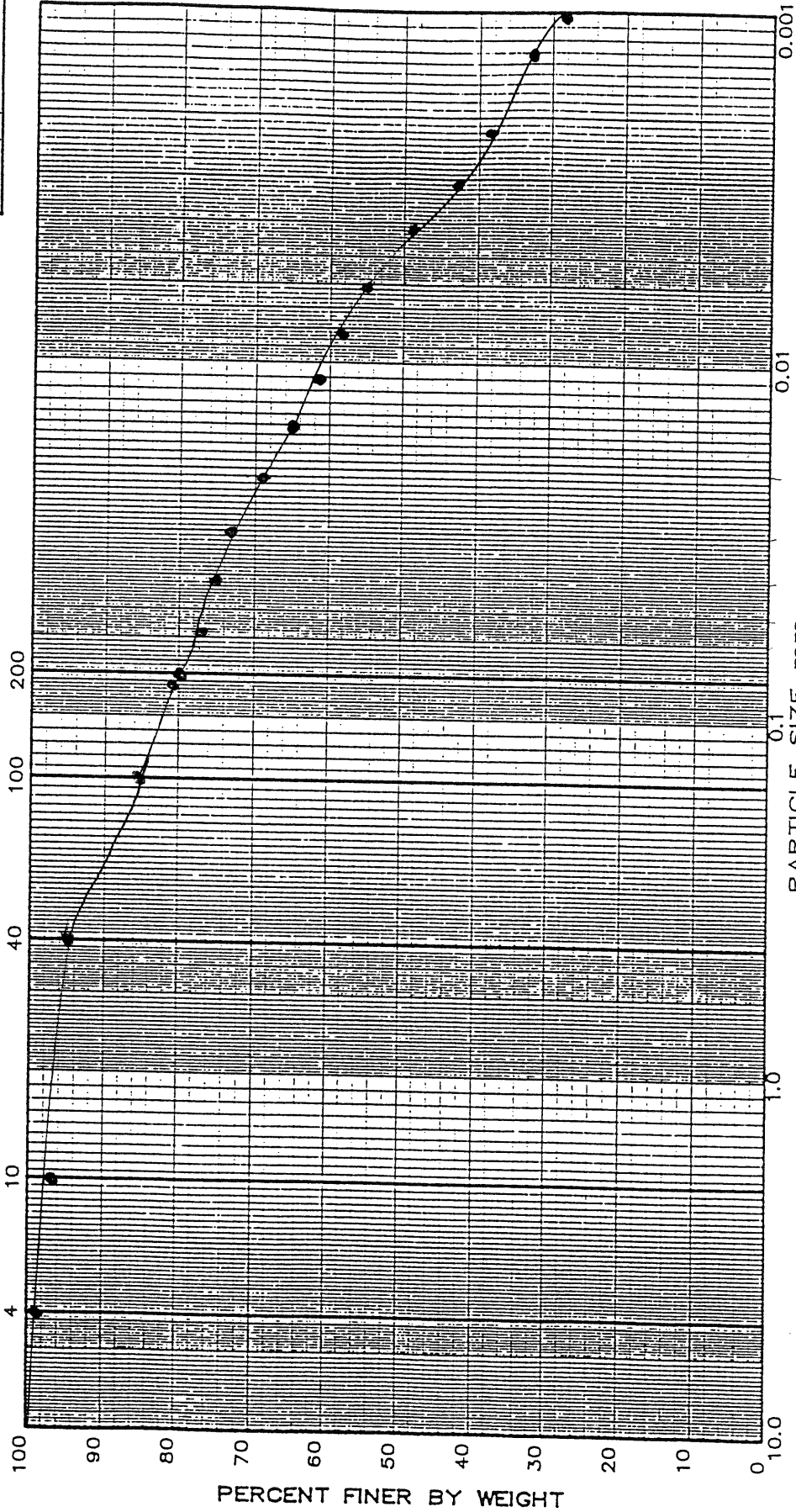
NOTES

% Retained is based upon the weight retained in the sieves plus the "loss-by-wash" weight.  
The % Retained in the Pan includes the soils passing the #200 sieve plus the "loss-by-wash" weight.

JOB NO. 940387

DATE 9/1/94

U.S. STANDARD SIEVE SIZE



GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT OR CLAY
1.00	1.35	2.35	15.50	79.80
BORING NO.	SAMPLE NO.	DEPTH	ASTM CLASSIFICATION	SOIL DESCRIPTION
DB-5	--	53-55'	CL-LEAN CLAY WITH SAND	SANDY CLAY

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PARTICLE SIZE DISTRIBUTION

## *1995 Aquifer Testing, Data, and Calculations*

## **APPENDIX D**

### **• AQUIFER TESTING, DATA, AND CALCULATIONS •**

## AQUIFER TESTING, DATA, AND CALCULATIONS

Rising and falling head slug tests are used to calculate preliminary values for hydraulic conductivity for water-bearing zones. Hydraulic conductivity is the rate at which water can flow through the aquifer under a unit hydraulic gradient. Values obtained from the slug tests represent point measurements which provide an evaluation of aquifer hydraulic conductivity near the well.

Hydraulic testing was conducted at the Ottawa County Farms Landfill on September 1, 2, and 6, 1994. Slug tests were performed in wells MW-2R, MW-11, MW-12, DB-1, DB-2, DB-3, DB-5, DB-11, and DB-14 through DB-17 to estimate the hydraulic conductivity of the saturated zones adjacent to the wells.

Field data were plotted as change in water level versus time (see attached graphs). The data were analyzed using the method of Bouwer and Rice (1976) and the results are presented in the attached table. The method was originally developed for unconfined aquifers and the method gives reasonable values of hydraulic conductivity of confined and semiconfined aquifers Bouwer (1989). Depending on the filter pack used for the well and the aquifer material, adjustments are made to both the  $r_c$  (radius of the well casing) and  $r_w$  (radial distance from the center of the well to undisturbed aquifer material) to provide reasonable data. The  $r_c$  parameter is adjusted up if the filter pack has a higher hydraulic conductivity than the aquifer material and the  $r_w$  is adjusted up if filter pack has a lower hydraulic conductivity than the aquifer material.

# SUMMARY OF HYDRAULIC CONDUCTIVITIES

## LAIDLAW WASTE SYSTEM

15550 68th Avenue  
Coopersville, Michigan 49404

WELL	TEST #	HYDRAULIC CONDUCTIVITY (K)	
		ft/day	cm/sec
DB-1	2	16.2	5.70E-03
DB-2	2	14.4	5.10E-03
DB-3	2	15.8	5.56E-03
DB-5	2	14.7	5.19E-03
DB-11	2	49.8	1.76E-03
DB-14	2	8.4	2.97E-03
DB-15	2	26.9	9.49E-03
DB-16	2	37.1	1.31E-02
DB-17	1	0.0144	5.08E-06
MW-11	1	0.0030	1.06E-06
MW-12	1	0.0763	2.69E-05
MW-2R	2	19.74	6.96E-03

### Notes:

- 1 Data collected on Sep. 1/2/6, 1994.
- 2 Data analysed on Sep. 12, 1994.



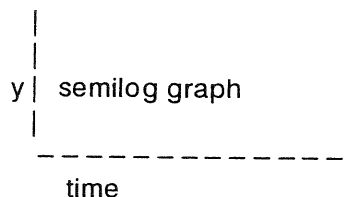
BOUWER AND RICE SLUG TEST WORKSHEET  
LAIDLAW WASTE SYSEY

1 OF 3

This worksheet presents a method of interpretation of slug test data, based on the Bouwer & Rice method.  
Data collected SEP. 1/2/6, 1994. Data analysed SEP. 12, 1994.

Page 1: Procedures

1. Plot on semi-log paper, time on the arithmetic scale versus difference in head from static conditions (y) on the logarithmic scale.



2. Fit a straight line through the data and from the graph, find  $y_0$  and  $y_t$  for an arbitrarily chosen  $t$  value.

3. Calculate:

$$K = \frac{rc^2 \ln(Re/rw)}{2Le} - (1/t) \ln(y_0/y_t)$$

Where:

$K$  = hydraulic conductivity  
 $rc$  = radius of the well casing  
 $rw$  = radial distance from the center of the well to normal  $K$  of the aquifer  
 $Re$  = the effective radius over which  $y$  is dissipated  
 $Le$  = the length of the well screen  
 $Lw$  = the penetration depth of the well into the aquifer  
 $H$  = thickness of the aquifer  
 $t$  = time since beginning of test  
 $y_0$  = change in water level at beginning of test  
 $y_t$  = water level at  $t$

and:

$$\ln(Re/rw) = \frac{1.1}{\ln(Lw/rw)} \left[ A + B \ln \left[ \frac{(H-Lw)/rw}{Le/rw} \right] \right]^{-1}$$

Where:

$A$  = from curves generated by analog analyses  
 $B$  = from curves generated by analog analyses

# BOUWER AND RICE SLUG TEST WORKSHEET

Page 2

Calculations

Given:

Well and aquifer parameters:

	DB-1	DB-2	DB-3	DB-5
H(ft) =	180.0	180.0	180.0	50.0
Le(ft) =	5.0	5.0	5.0	5.0
Lw(ft) =	157.0	155.0	168.0	36.5
rw(ft) =	0.375	0.375	0.375	0.375
rc(ft) =	0.201	0.201	0.201	0.201
Le/rw =	13.3	13.3	13.3	13.3

Curve values:

A =	1.9	1.9	1.9	1.9
B =	0.3	0.3	0.3	0.3

Calculation of  $\ln(Re/rw)$

Well No.	Test No.	Le (ft)	Lw (ft)	rw (ft)	H (ft)	A	B	$\ln(Re/rw)$
DB-1	1	5.0	157.0	0.375	180.0	1.9	0.3	2.8
DB-2	1	5.0	155.0	0.375	180.0	1.9	0.3	2.8
DB-3	1	5.0	168.0	0.375	180.0	1.9	0.3	2.8
DB-5	1	5.0	36.5	0.375	50.0	1.9	0.3	2.4

Calculation of Hydraulic Conductivity (K) and Transmissivity (T)

Well No.	Test No.	$\ln(Re/rw)$	rc (ft)	Le (ft)	t (sec)	y0 (ft)	yt (ft)	K (ft/min)	K (ft/d)	K (cm/sec)	T (ft <sup>2</sup> /d)
DB-1	1	2.8	0.201	5.0	100.0	1.7	0.4	0.0099	14.29	5.04E-03	2572
	2	2.8	0.201	5.0	100.0	1.6	0.3	0.0125	18.03	6.36E-03	3245
DB-2	1	2.8	0.201	5.0	155.0	1.6	0.2	0.0100	14.34	5.06E-03	2581
	2	2.8	0.201	5.0	168.0	1.6	0.1	0.0101	14.55	5.13E-03	2619
DB-3	1	2.8	0.201	5.0	200.0	1.7	0.1	0.0104	14.99	5.29E-03	2698
	2	2.8	0.201	5.0	300.0	1.7	0.0	0.0115	16.55	5.84E-03	2978
DB-5	1	2.4	0.201	5.0	50.0	1.6	0.6	0.0109	15.77	5.56E-03	788
	2	2.4	0.201	5.0	100.0	1.7	0.3	0.0095	13.68	4.83E-03	684

## STATISTICAL SUMMARY

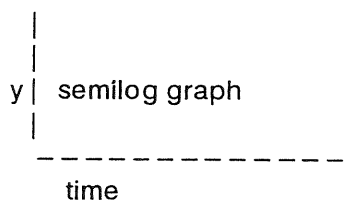
WELL	ARITHMETIC MEAN	ft/d	cm/sec
DB-1	16.2	5.70E-03	
DB-2	14.4	5.10E-03	
DB-3	15.8	5.56E-03	
DB-5	14.7	5.19E-03	

BOUWER AND RICE SLUG TEST WORKSHEET  
LAIDLAW WASTE SYSTEM  
2 OF 3

This worksheet presents a method of interpretation of slug test data, based on the Bouwer & Rice method.  
Data collected SEP. 1/2/6, 1994.      Data analysed SEP. 12, 1994.

Page 1: Procedures

1. Plot on semi-log paper, time on the arithmetic scale versus difference in head from static conditions (y) on the logarithmic scale.



2. Fit a straight line through the data and from the graph, find  $y_0$  and  $y_t$  for an arbitrarily chosen  $t$  value.

3. Calculate:

$$K = \frac{rc^2 \ln(Re/rw)}{2Le} \left( \frac{1}{t} \right) \ln(y_0/y_t)$$

Where:

$K$  = hydraulic conductivity  
 $rc$  = radius of the well casing  
 $rw$  = radial distance from the center of the well to normal  $K$  of the aquifer  
 $Re$  = the effective radius over which  $y$  is dissipated  
 $Le$  = the length of the well screen  
 $Lw$  = the penetration depth of the well into the aquifer  
 $H$  = thickness of the aquifer  
 $t$  = time since beginning of test  
 $y_0$  = change in water level at beginning of test  
 $y_t$  = water level at  $t$

and:

$$\ln(Re/rw) = \frac{1.1}{\ln(Lw/rw)} + \frac{A + B \ln[(H-Lw)/rw]}{Le/rw}$$

Where:

$A$  = from curves generated by analog analyses  
 $B$  = from curves generated by analog analyses

# BOUWER AND RICE SLUG TEST WORKSHEET

Page 2

Calculations

Given:

Well and aquifer parameters:

	DB-11	DB-14	DB-15	DB-16
H(ft) =	120.0	120.0	50.0	120.0
Le(ft) =	5.0	5.0	5.0	5.0
Lw(ft) =	81.0	106.5	37.0	81.0
rw(ft) =	0.458	0.375	0.375	0.458
rc(ft) =	0.083	0.201	0.201	0.083
Le/rw =	10.9	13.3	13.3	10.9

Curve values:

A =	1.8	1.9	1.9	1.8
B =	0.3	0.3	0.3	0.3

Calculation of  $\ln(Re/rw)$

Well No.	Test No.	Le (ft)	Lw (ft)	rw (ft)	H (ft)	A	B	$\ln(Re/rw)$
DB-11	1	5.0	81.0	0.458	120.0	1.8	0.3	2.3
DB-14	1	5.0	106.5	0.375	120.0	1.9	0.3	2.7
DB-15	1	5.0	37.0	0.375	50.0	1.9	0.3	2.4
DB-16	1	5.0	81.0	0.375	120.0	1.8	0.3	2.6

Calculation of Hydraulic Conductivity (K) and Transmissivity (T)

Well No.	Test No.	$\ln(Re/rw)$	rc (ft)	Le (ft)	t (sec)	y0 (ft)	yt (ft)	K (ft/min)	K (ft/d)	K (cm/sec)	T (ft <sup>2</sup> /d)
DB-11	1	2.3	0.083	5.0	16.0	0.6	0.0	0.0335	48.21	1.70E-02	5785
	2	2.3	0.083	5.0	15.0	0.6	0.0	0.0357	51.42	1.81E-02	6170
DB-14	1	2.7	0.201	5.0	405.0	1.7	0.1	0.0053	7.59	2.68E-03	911
	2	2.7	0.201	5.0	310.0	1.7	0.1	0.0064	9.25	3.26E-03	1110
DB-15	1	2.4	0.201	5.0	50.0	0.6	0.1	0.0185	26.64	9.40E-03	1332
	2	2.4	0.201	5.0	49.0	0.6	0.1	0.0189	27.18	9.59E-03	1359
DB-16	1	2.6	0.083	5.0	25.0	1.6	0.0	0.0262	37.76	1.33E-02	4531
	2	2.6	0.083	5.0	20.0	1.6	0.0	0.0252	36.36	1.28E-02	4363

## STATISTICAL SUMMARY

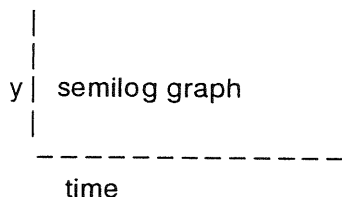
WELL	ARITHMETIC MEAN	
	ft/d	cm/sec
DB-11	49.8	1.76E-02
DB-14	8.4	2.97E-03
DB-15	26.9	9.49E-03
DB-16	37.1	1.31E-02

BOUWER AND RICE SLUG TEST WORKSHEET  
LAILAW WASTE SYSEM  
3 OF 3

This worksheet presents a method of interpretation of slug test data, based on the Bouwer & Rice meth.  
Data collected SEP. 1/2/6, 1994. Data analysed SEP. 12, 1994.

Page 1: Procedures

1. Plot on semi-log paper, time on the arithmetic scale versus difference in head from static conditions (y) on the logarithmic scale.



2. Fit a straight line through the data and from the graph, find  $y_0$  and  $y_t$  for an arbitrarily chosen  $t$  value.

3. Calculate:

$$K = \frac{rc^2 \ln(Re/rw)}{2Le (1/t) \ln(y_0/y_t)}$$

Where:

$K$  = hydraulic conductivity  
 $rc$  = radius of the well casing  
 $rw$  = radial distance from the center of the well to normal  $K$  of the aquifer  
 $Re$  = the effective radius over which  $y$  is dissipated  
 $Le$  = the length of the well screen  
 $Lw$  = the penetration depth of the well into the aquifer  
 $H$  = thickness of the aquifer  
 $t$  = time since beginning of test  
 $y_0$  = change in water level at beginning of test  
 $y_t$  = water level at  $t$

and:

$$\ln(Re/rw) = \frac{1.1}{\ln(Lw/rw)} \left[ A + B \ln \left[ \frac{(H-Lw)/rw}{Le/rw} \right]^{-1} \right]$$

Where:

$A$  = from curves generated by analog analyses  
 $B$  = from curves generated by analog analyses

# BOUWER AND RICE SLUG TEST WORKSHEET

Page 2

Calculations

Given:

Well and aquifer parameters:

	DB-17	MW-11	MW-12	MW-2R
H(ft) =	120.0	50.0	50.0	120.0
Le(ft) =	5.0	2.5	3.0	5.0
Lw(ft) =	53.4	21.7	26.6	52.9
rw(ft) =	0.375	0.375	0.375	0.417
rc(ft) =	0.201	0.201	0.201	0.083
Le/rw =	13.3	6.7	8.0	12.0

Curve values:

A =	1.9	1.8	1.8	1.9
B =	0.3	0.3	0.3	0.3

Calculation of  $\ln(Re/rw)$

Well No.	Test No.	Le (ft)	Lw (ft)	rw (ft)	H (ft)	A	B	$\ln(Re/rw)$
DB-17	1	5.0	53.4	0.375	120.0	1.9	0.3	2.5
MW-11	1	2.5	21.7	0.375	50.0	1.8	0.3	1.6
MW-12	1	3.0	26.6	0.375	50.0	1.8	0.3	1.9
MW-2R	1	5.0	52.9	0.375	120.0	1.9	0.3	2.5

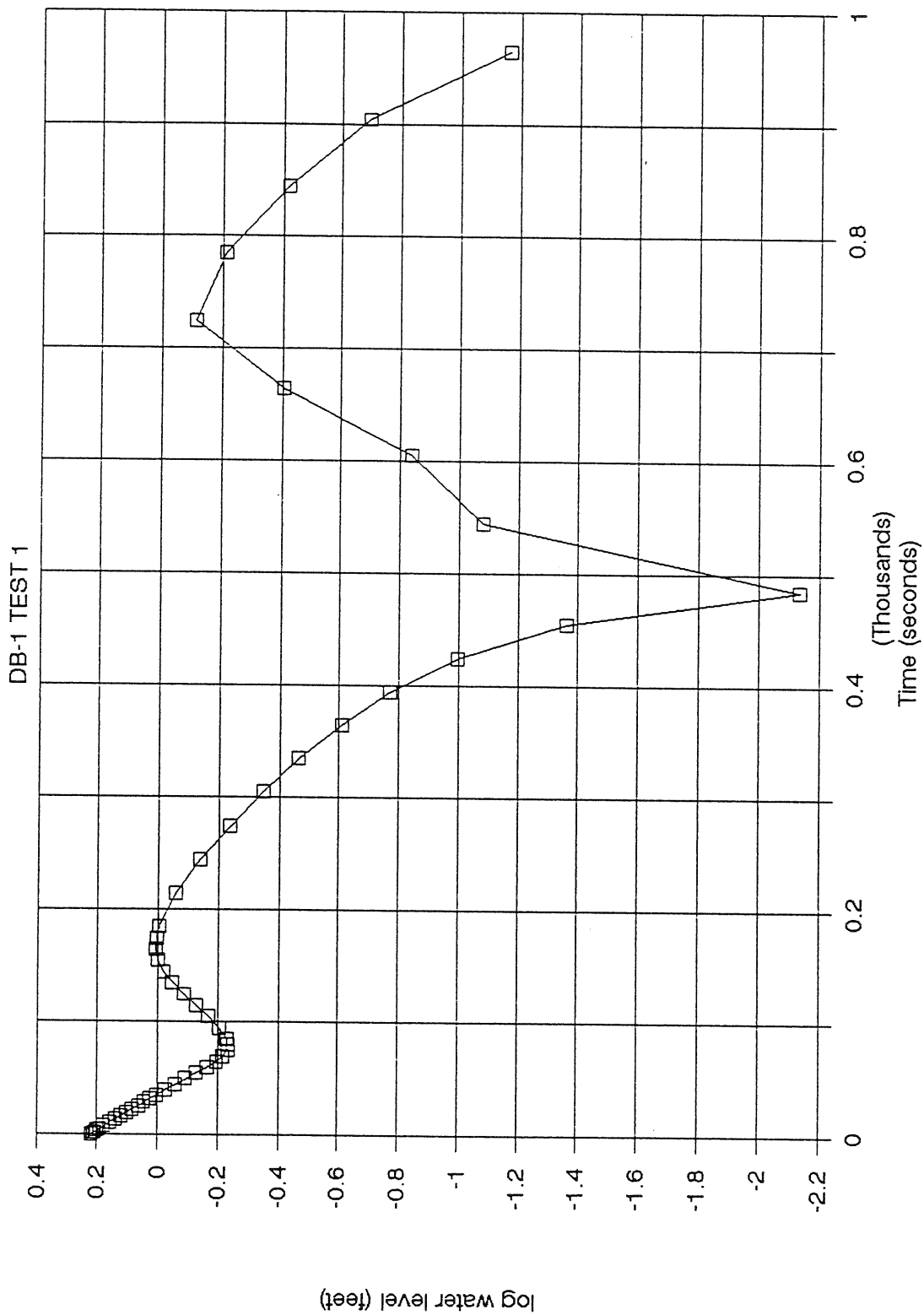
Calculation of Hydraulic Conductivity (K) and Transmissivity (T)

Well No.	Test No.	$\ln(Re/rw)$	rc (ft)	Le (ft)	t (sec)	y0 (ft)	yt (ft)	K (ft/min)	K (ft/d)	K (cm/sec)	T (ft <sup>2</sup> /d)
DB-17	1	2.5	0.201	5.0	19506.0	1.7	1.2	0.0000	0.0144	5.08E-06	2
MW-11	1	1.6	0.201	2.5	22800.0	1.5	1.5	0.0000	0.0030	1.06E-06	0
MW-12	1	1.9	0.201	3.0	22800.0	1.6	0.3	0.0001	0.0763	2.69E-05	4
MW-2R	1	2.5	0.083	5.0	40.0	1.6	0.0	0.0141	20.31	7.16E-03	2437
	2	2.5	0.083	5.0	30.0	1.6	0.0	0.0133	19.18	6.76E-03	2301

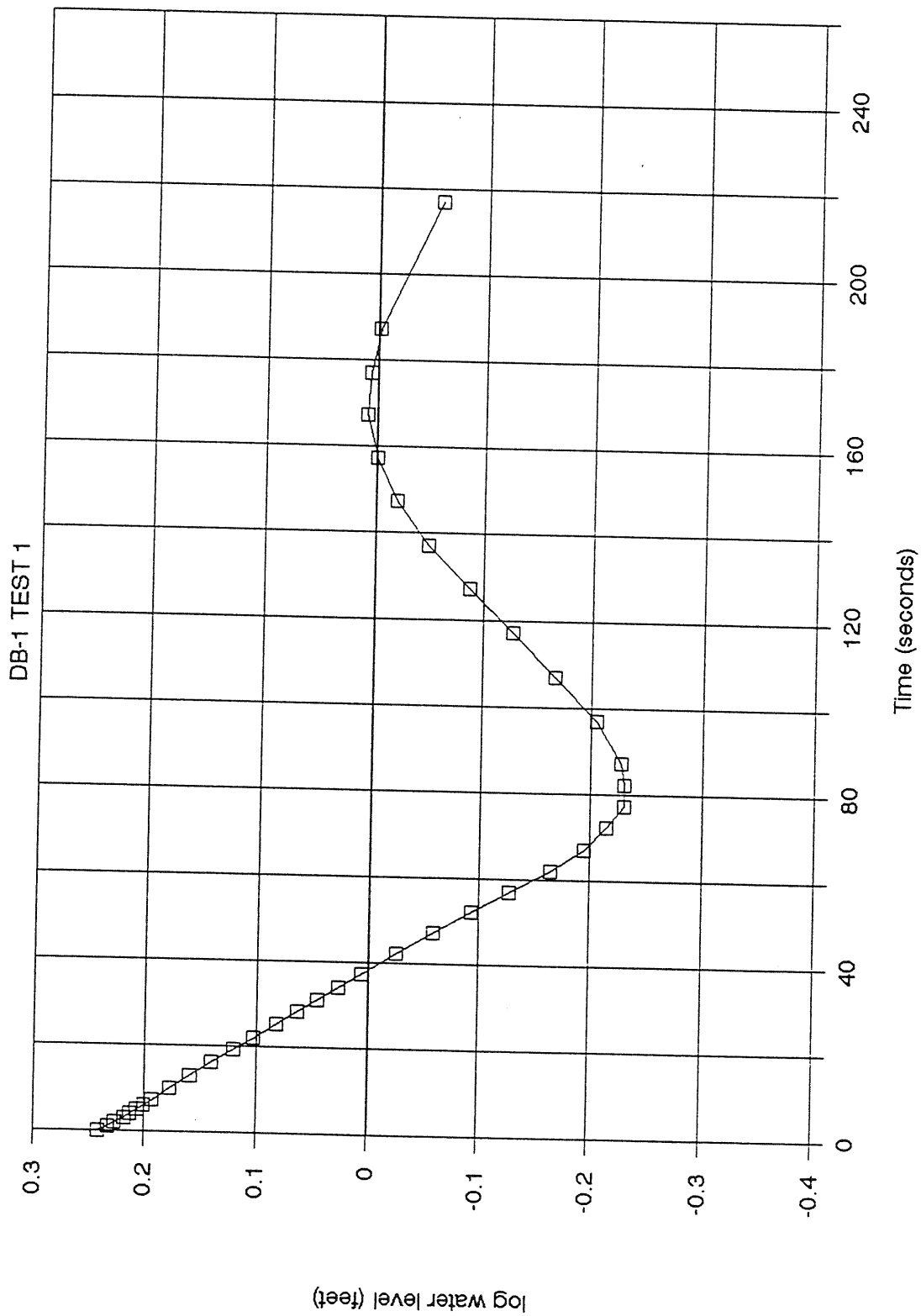
## STATISTICAL SUMMARY

WELL	ARITHMETIC MEAN	ft/d	cm/sec
DB-17	0.0144	5.08E-06	
MW-11	0.0030	1.06E-06	
MW-12	0.0763	2.69E-05	
MW-2R	19.74	6.96E-03	

# LAIDLAW WASTE SYSTEM

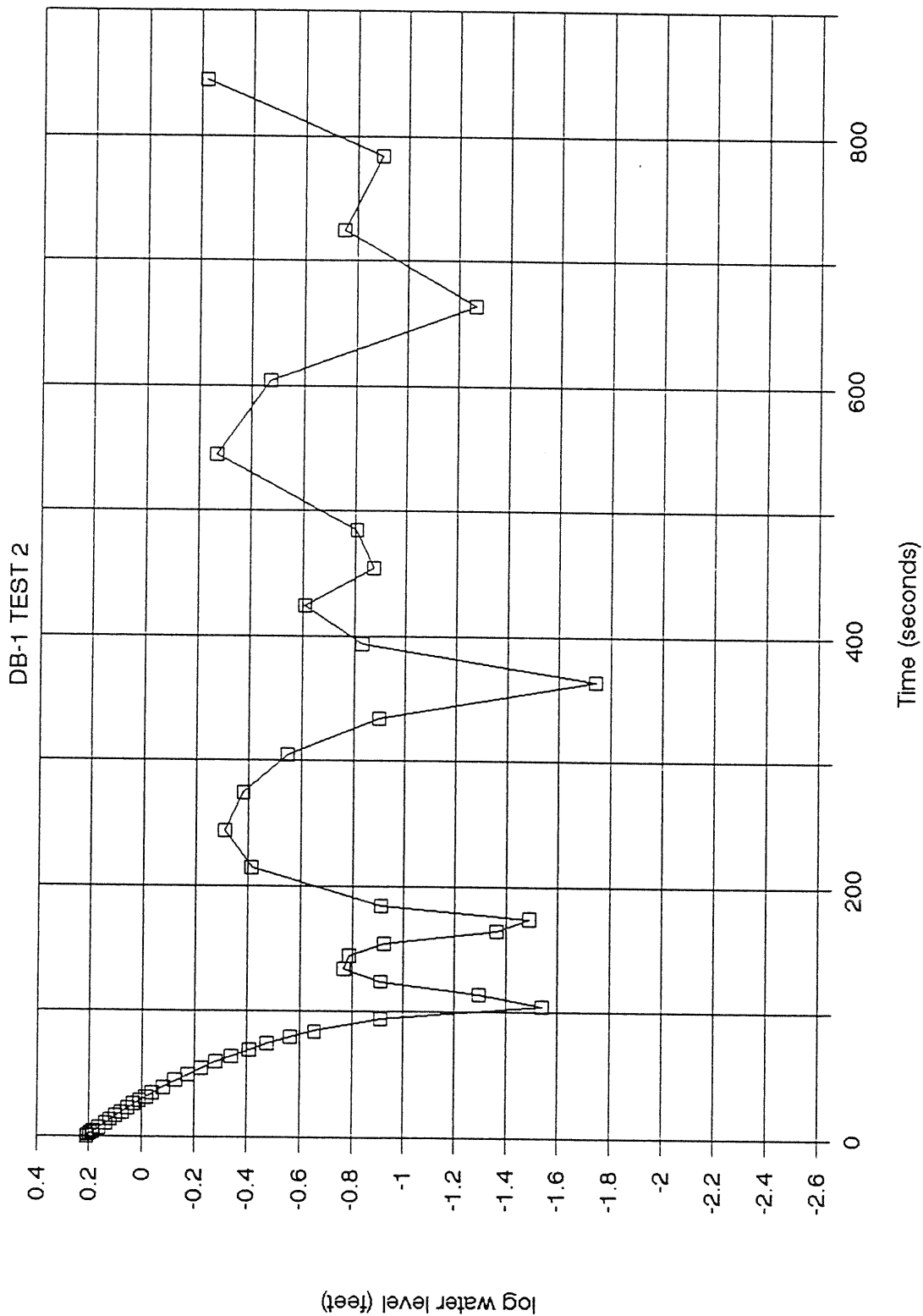


# LAILAW WASTE SYSTEMS

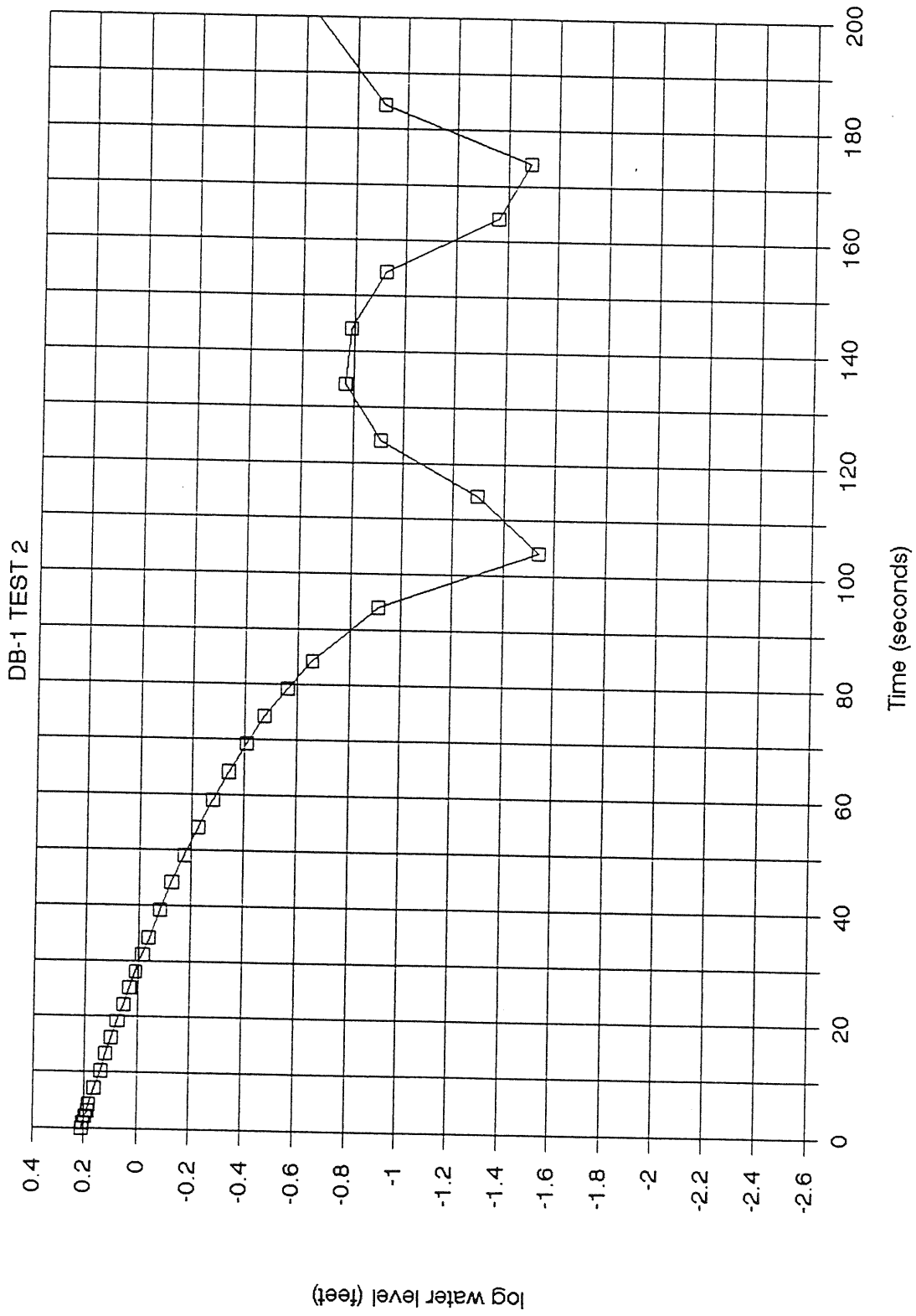




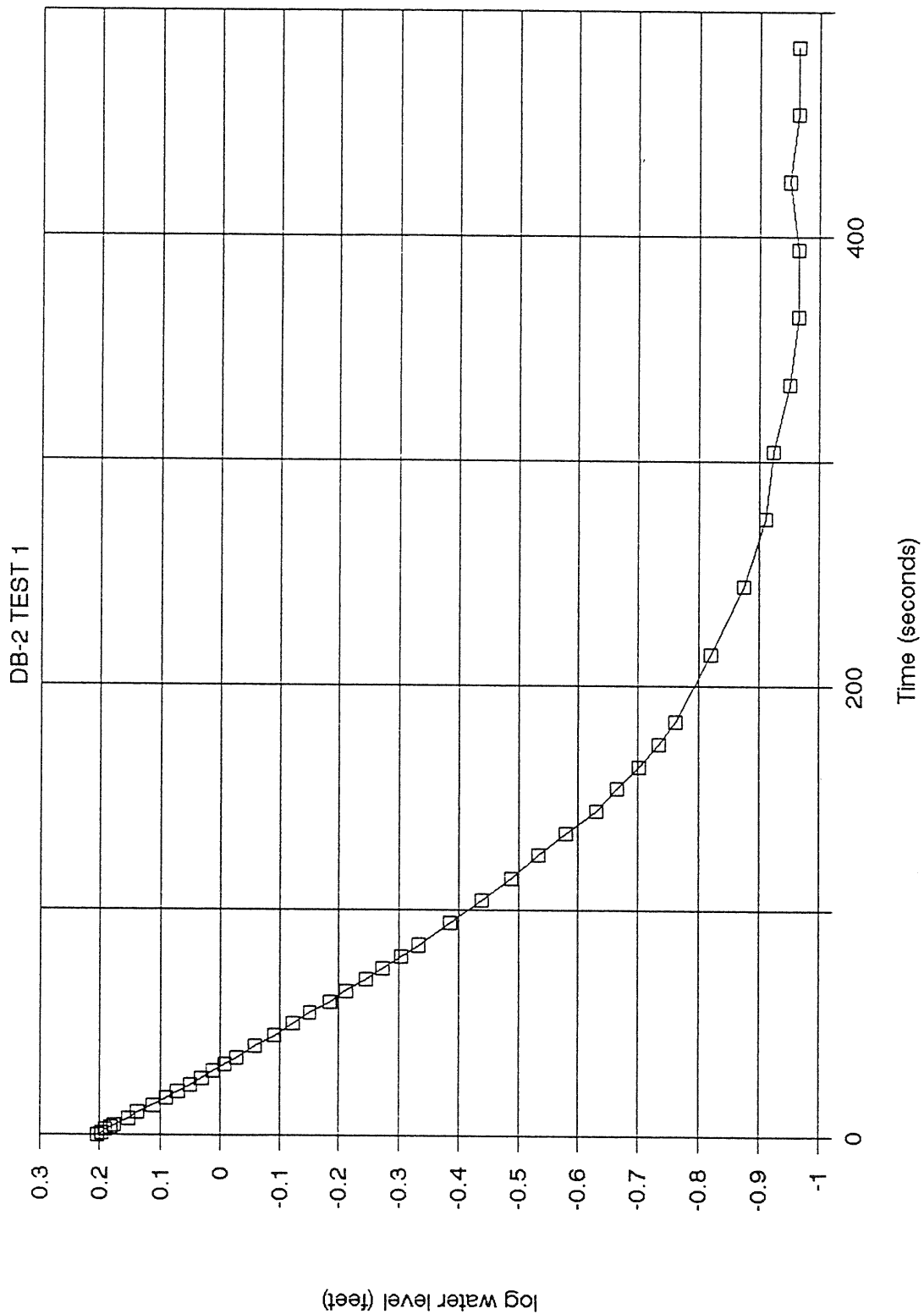
# LAIDLAW WASTE SYSTEM



# LAILAW WASTE SYSTEM

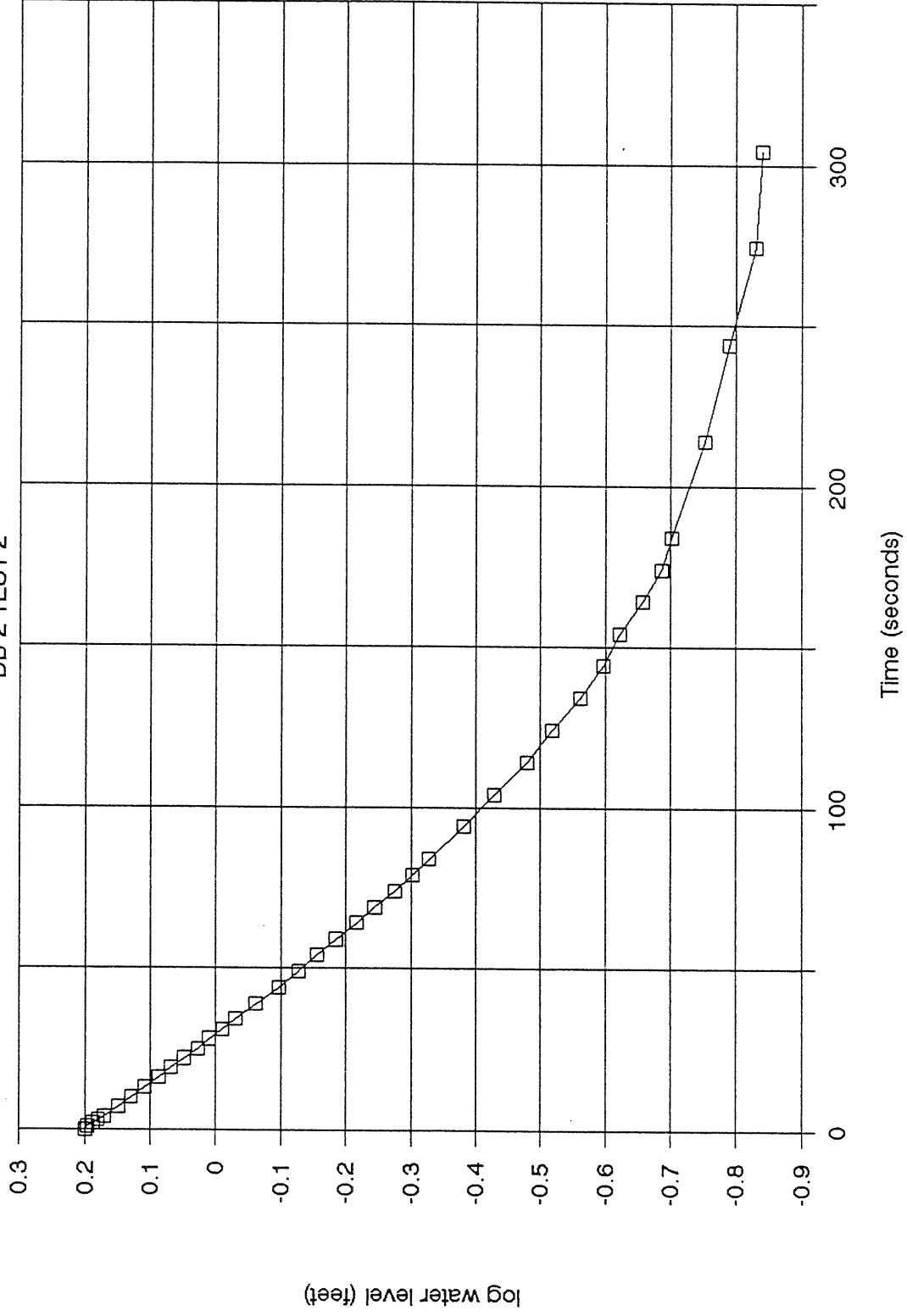


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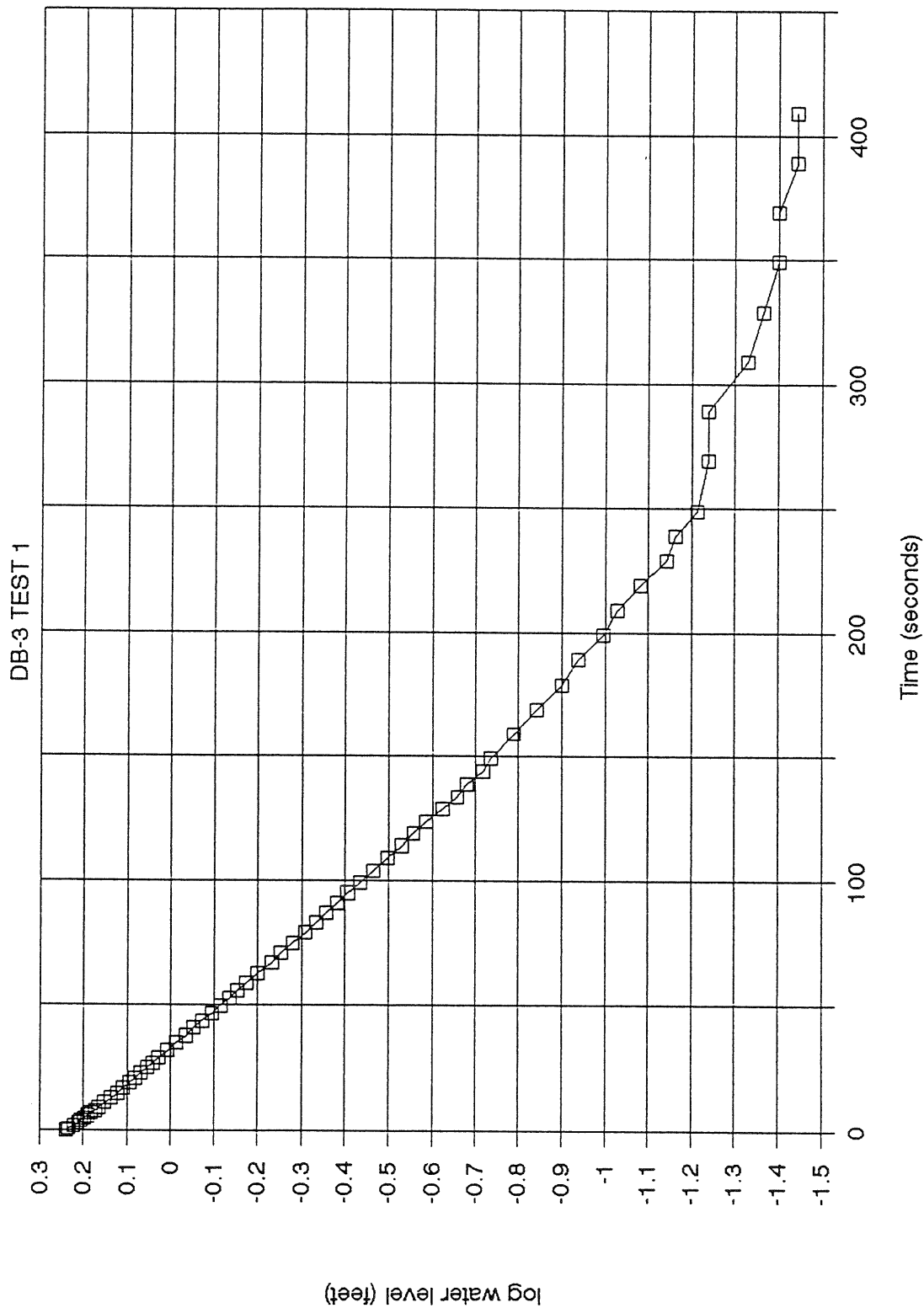


# LAILAW WASTE SYSTEM

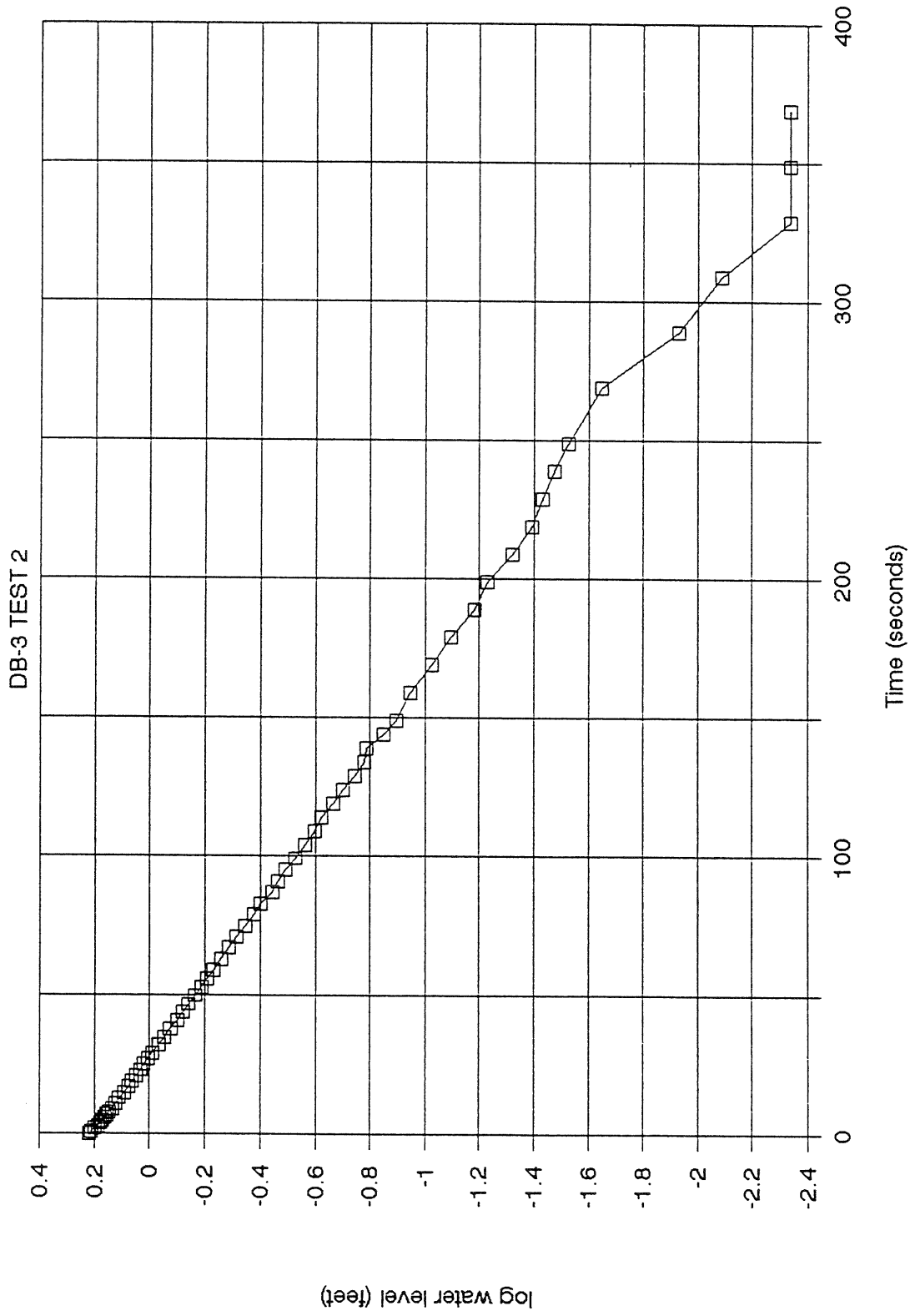
DB-2 TEST 2



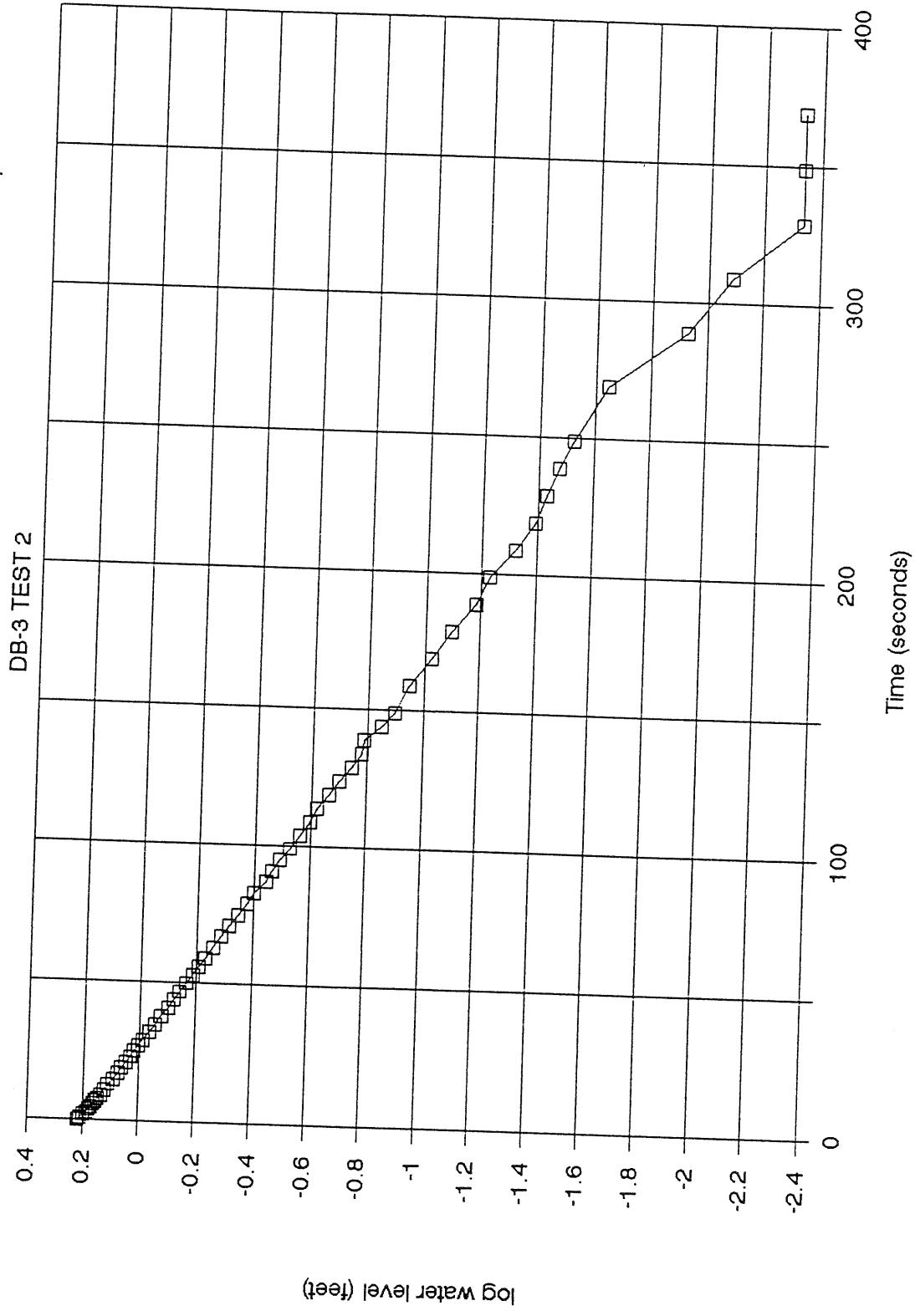
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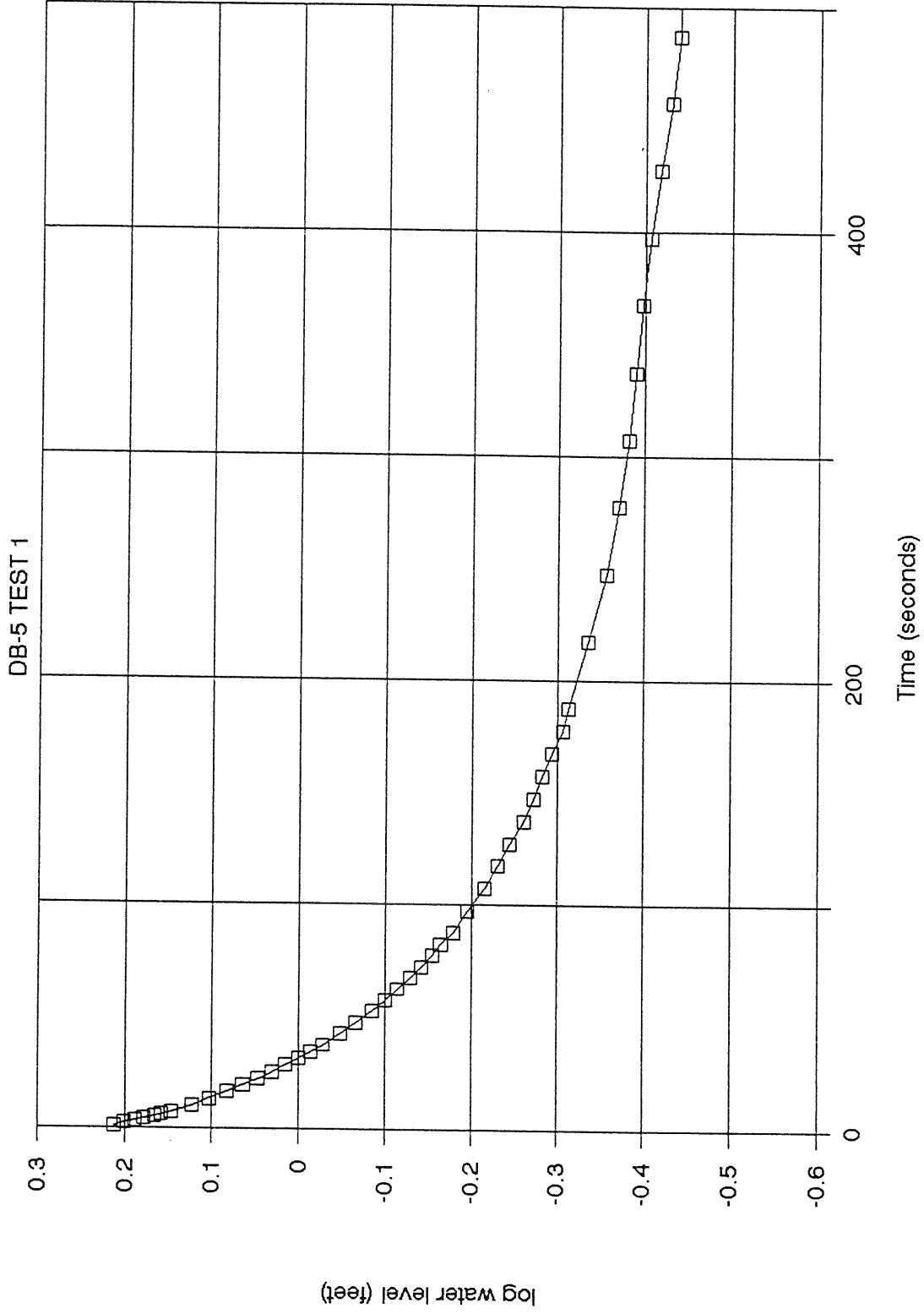
# LAIDLAW WASTE SYSTEM



# LAIDLAW WASTE SYSTEM



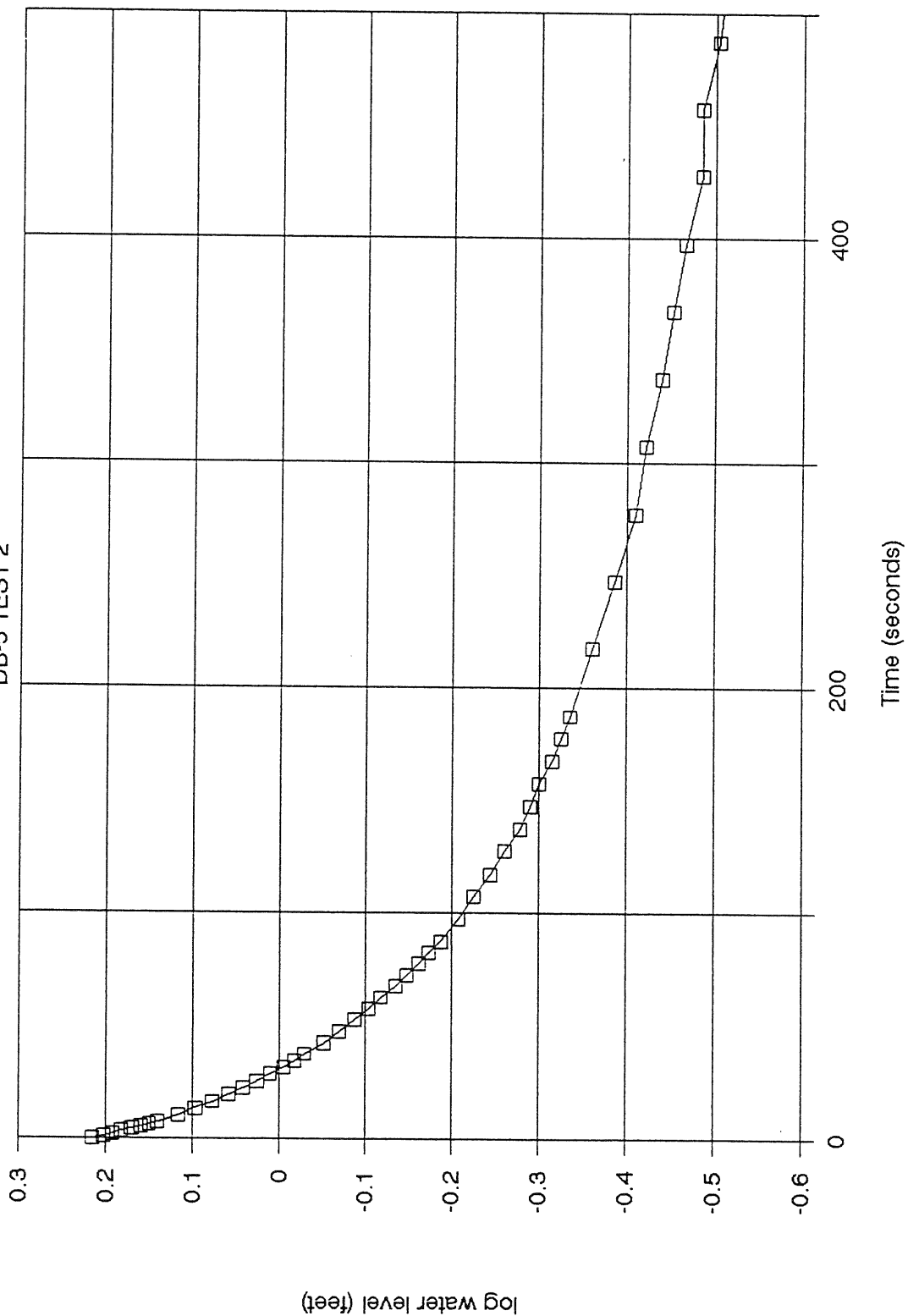
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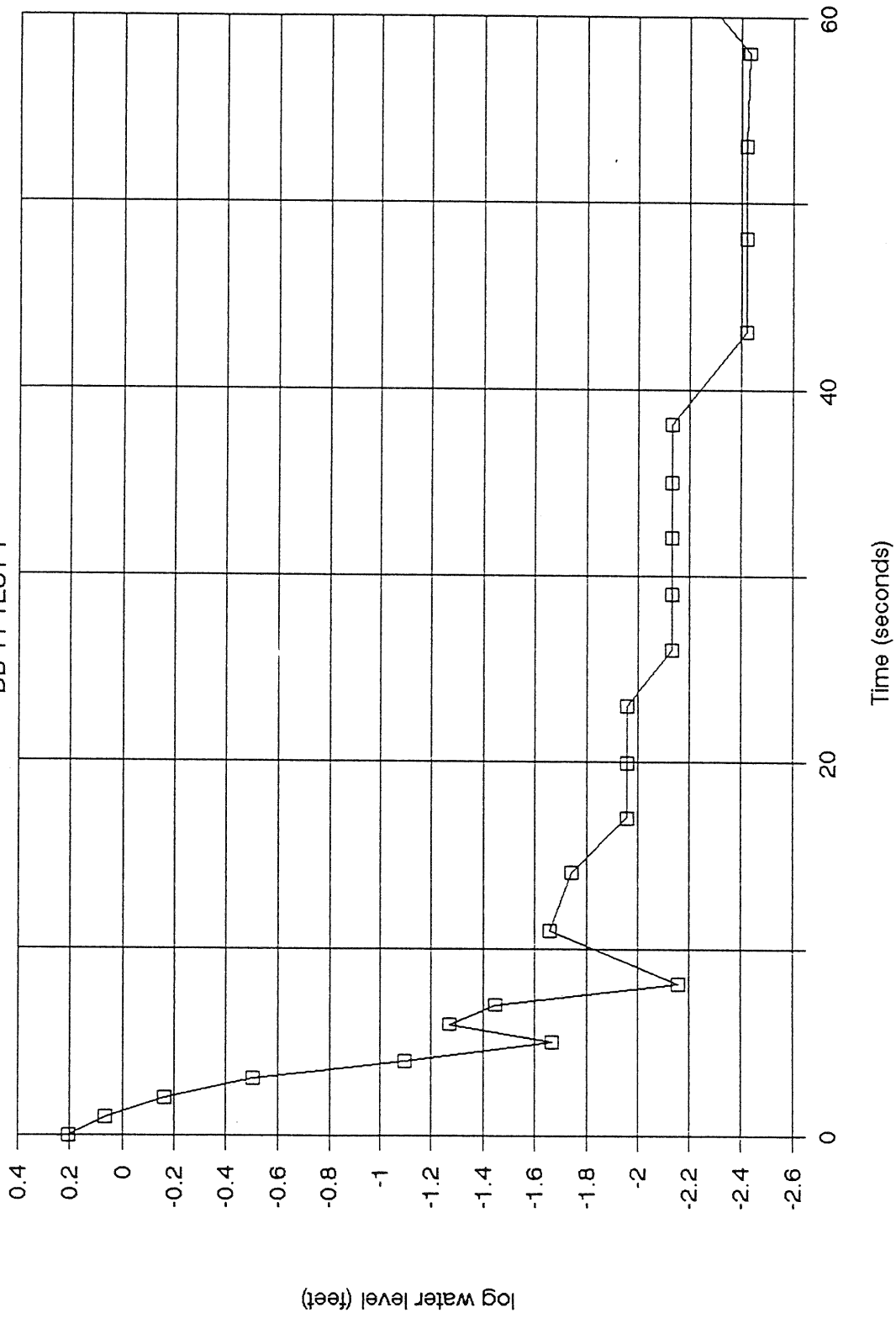
# LAILAW WASTE SYSTEM

DB-5 TEST 2



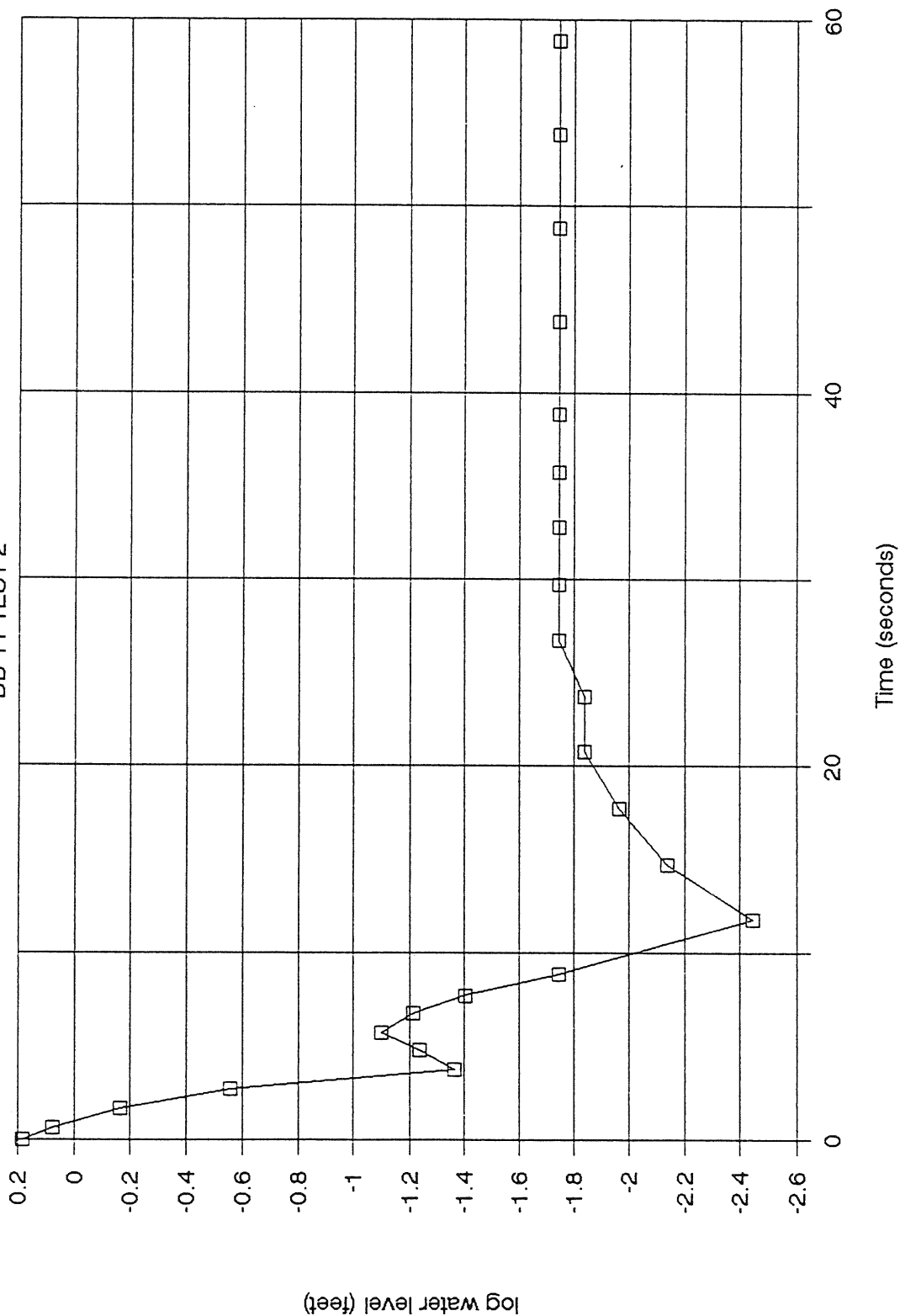
# LAILAW WASTE SYSTEM

DB-11 TEST 1

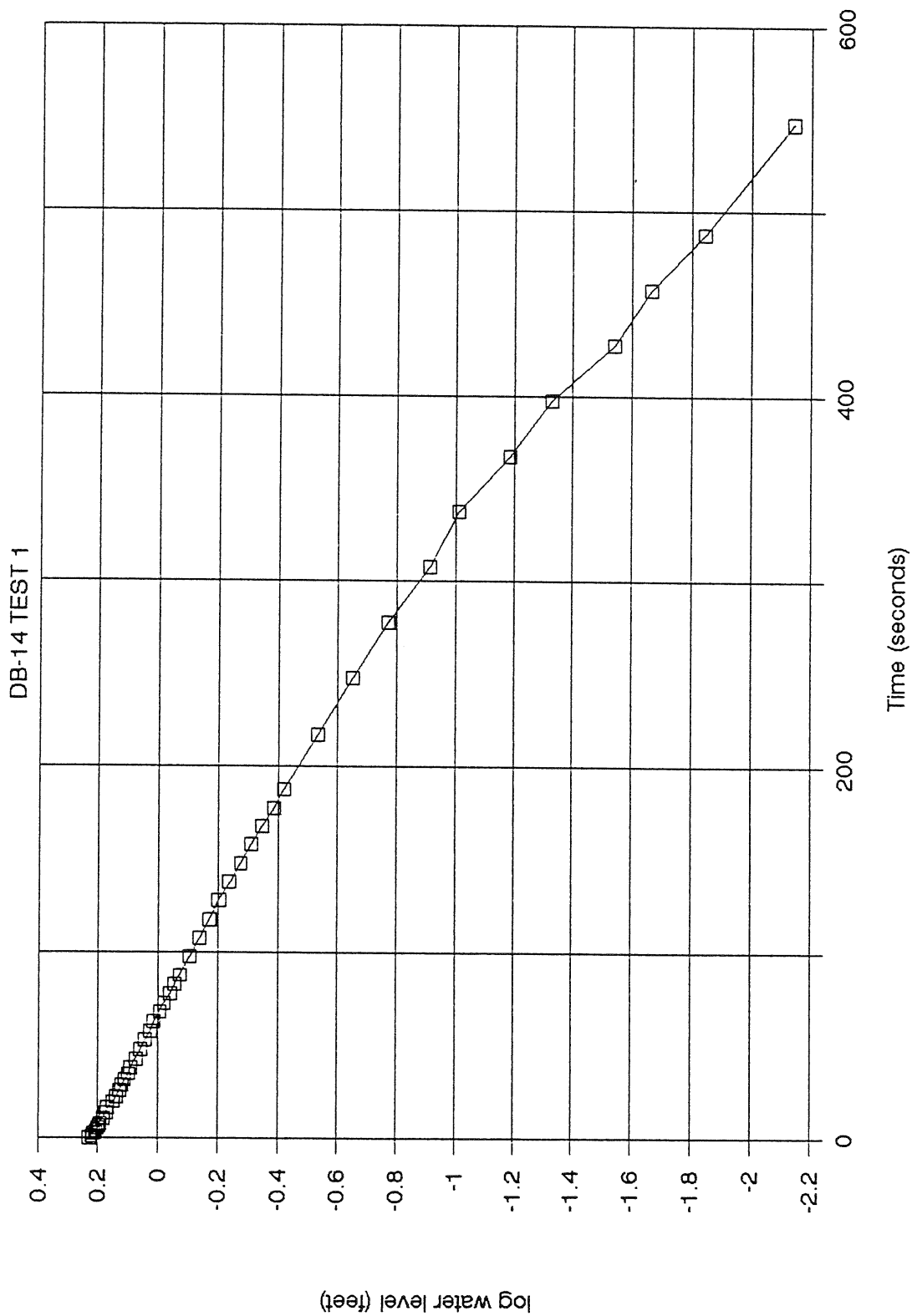


# LAIDLAW WASTE SYSTEM

DB-11 TEST 2

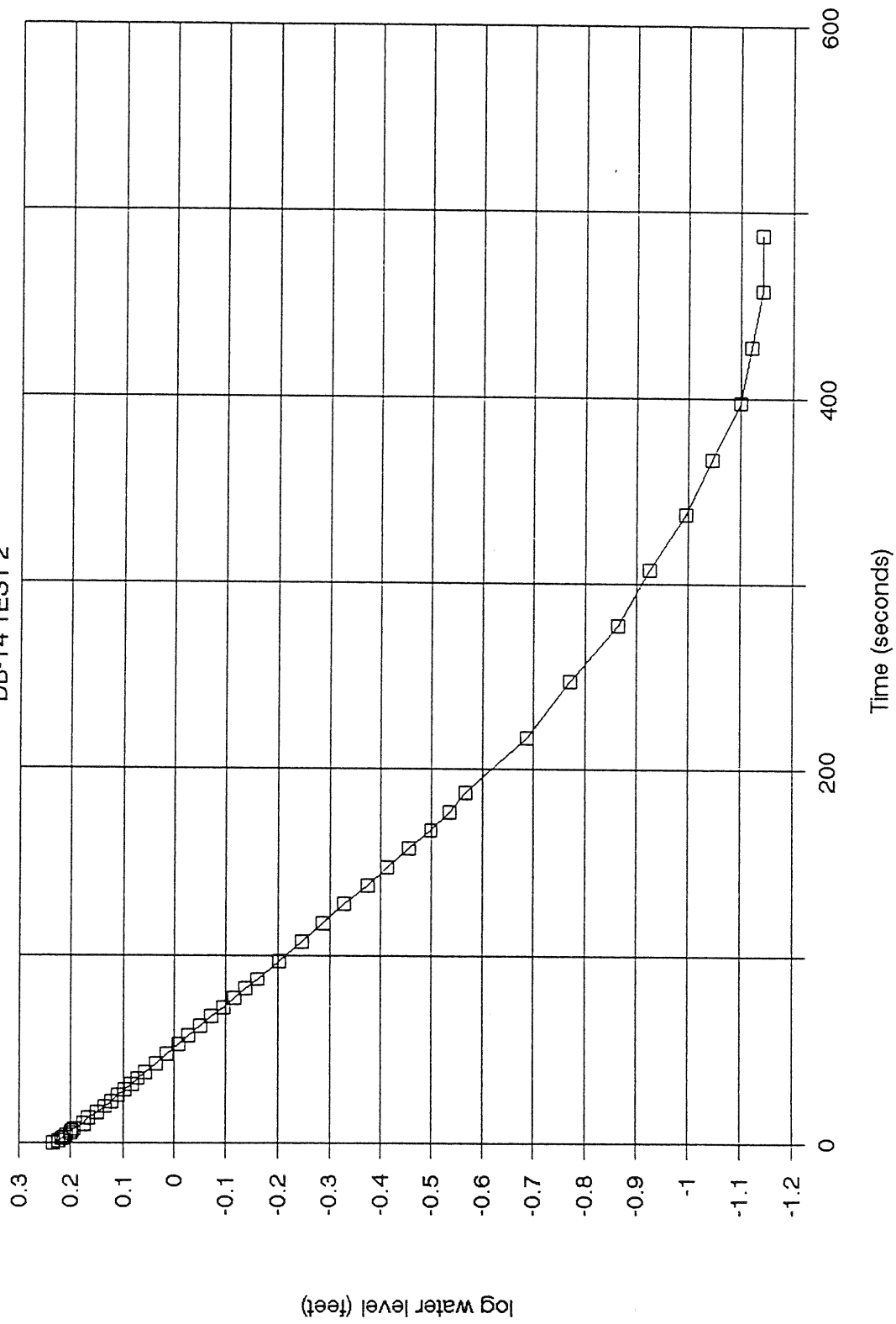


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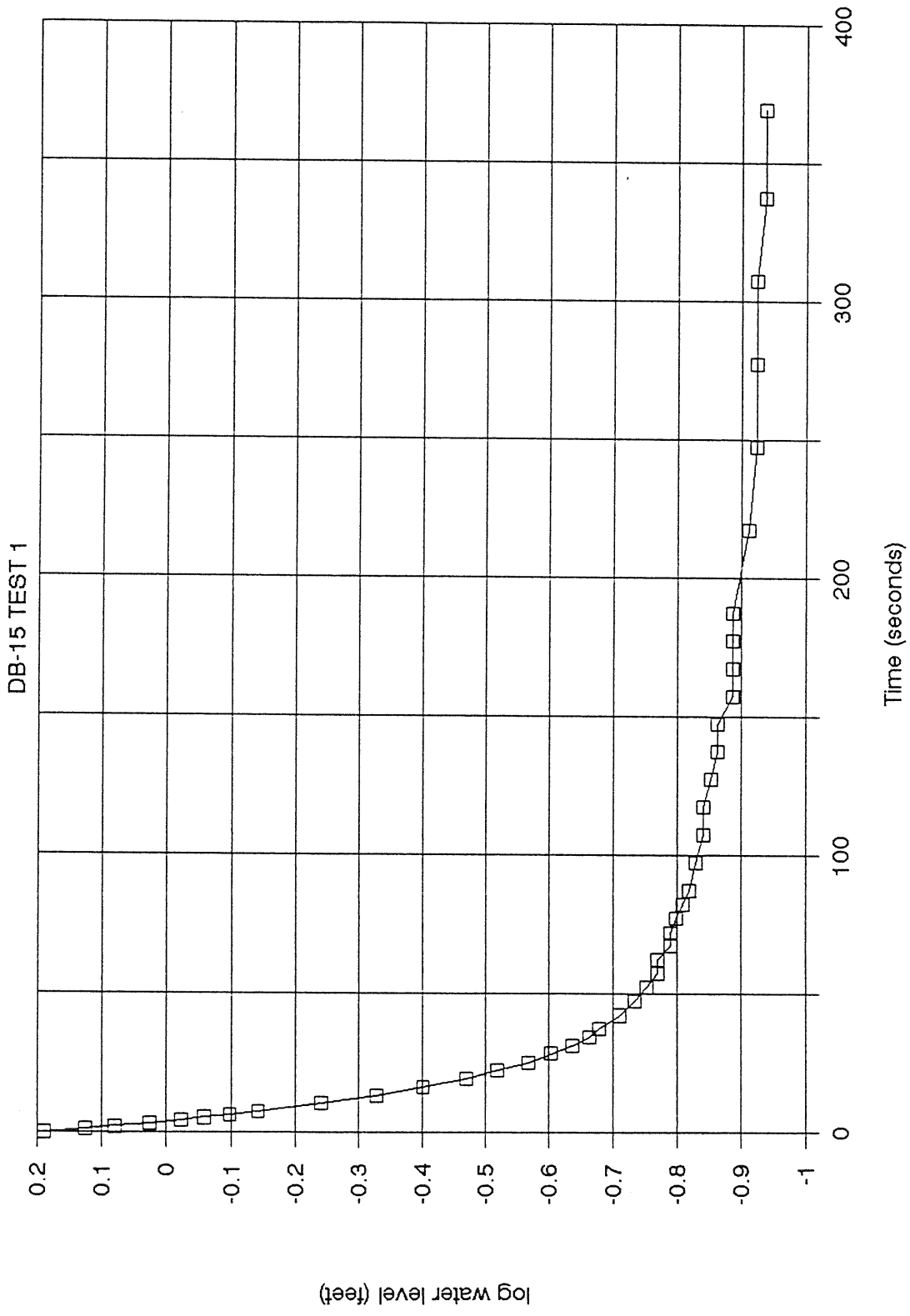


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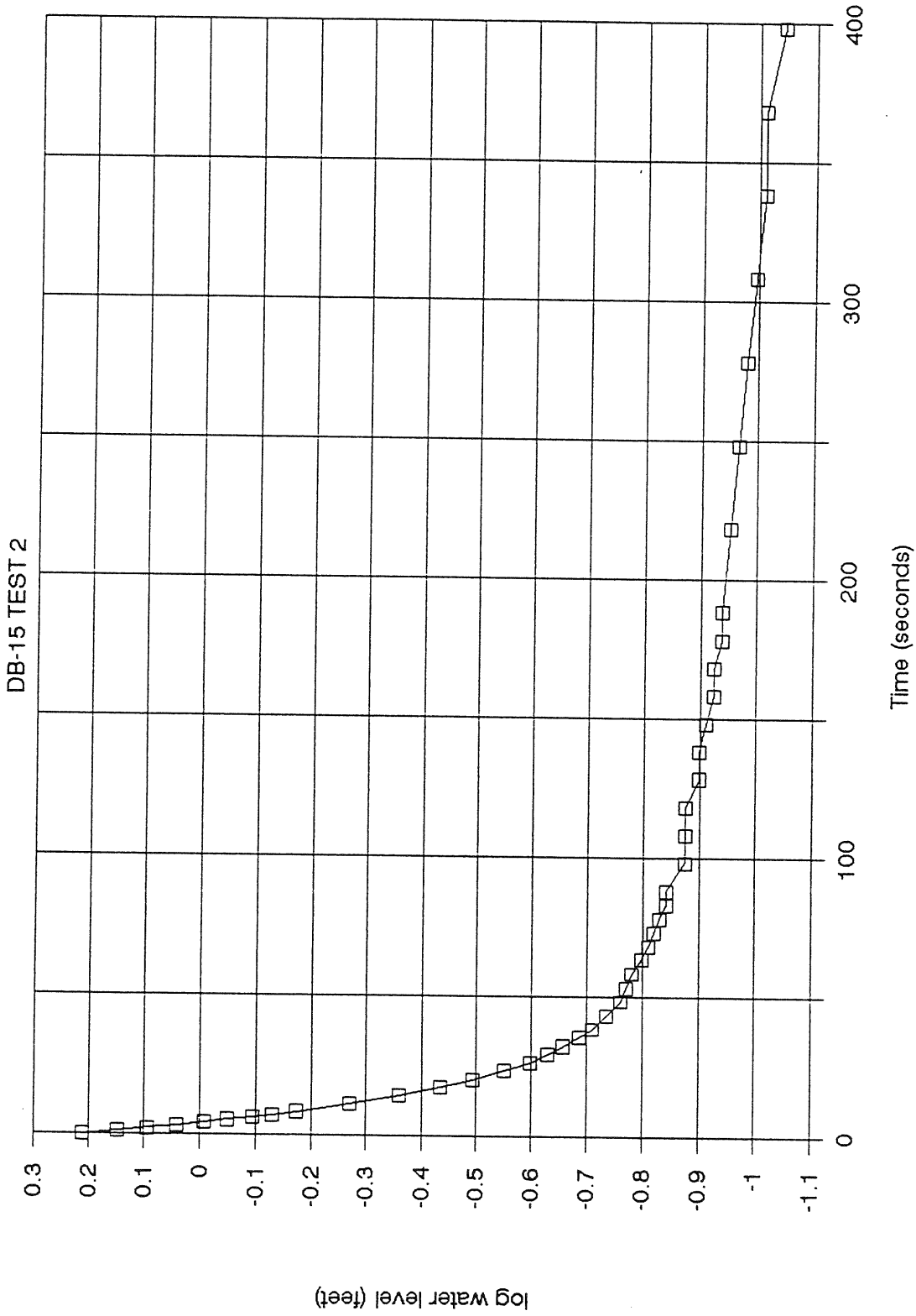
DB-14 TEST 2



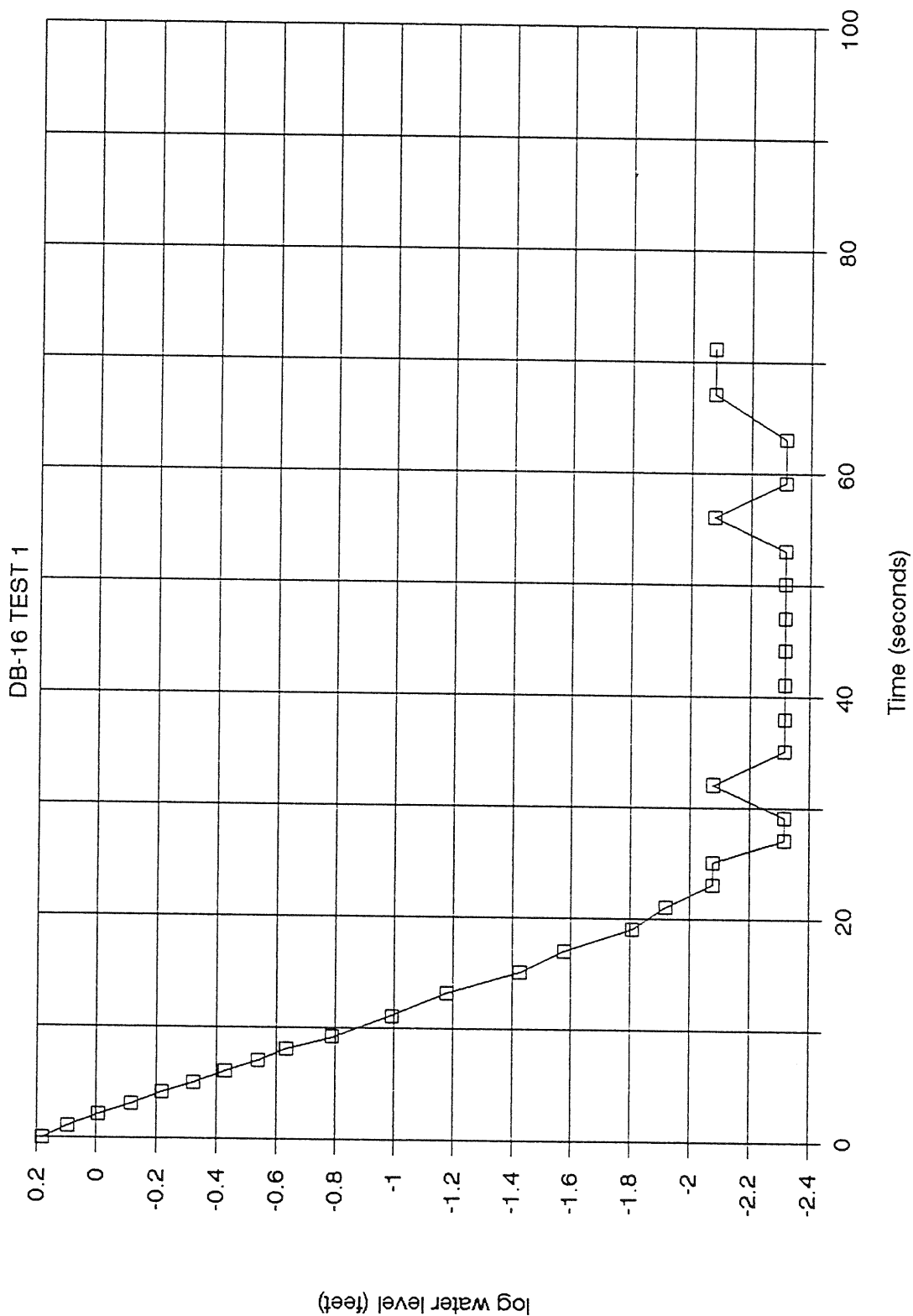
# LAIDLAW WASTE SYSTEM



# LAIDLAW WASTE SYSTEM

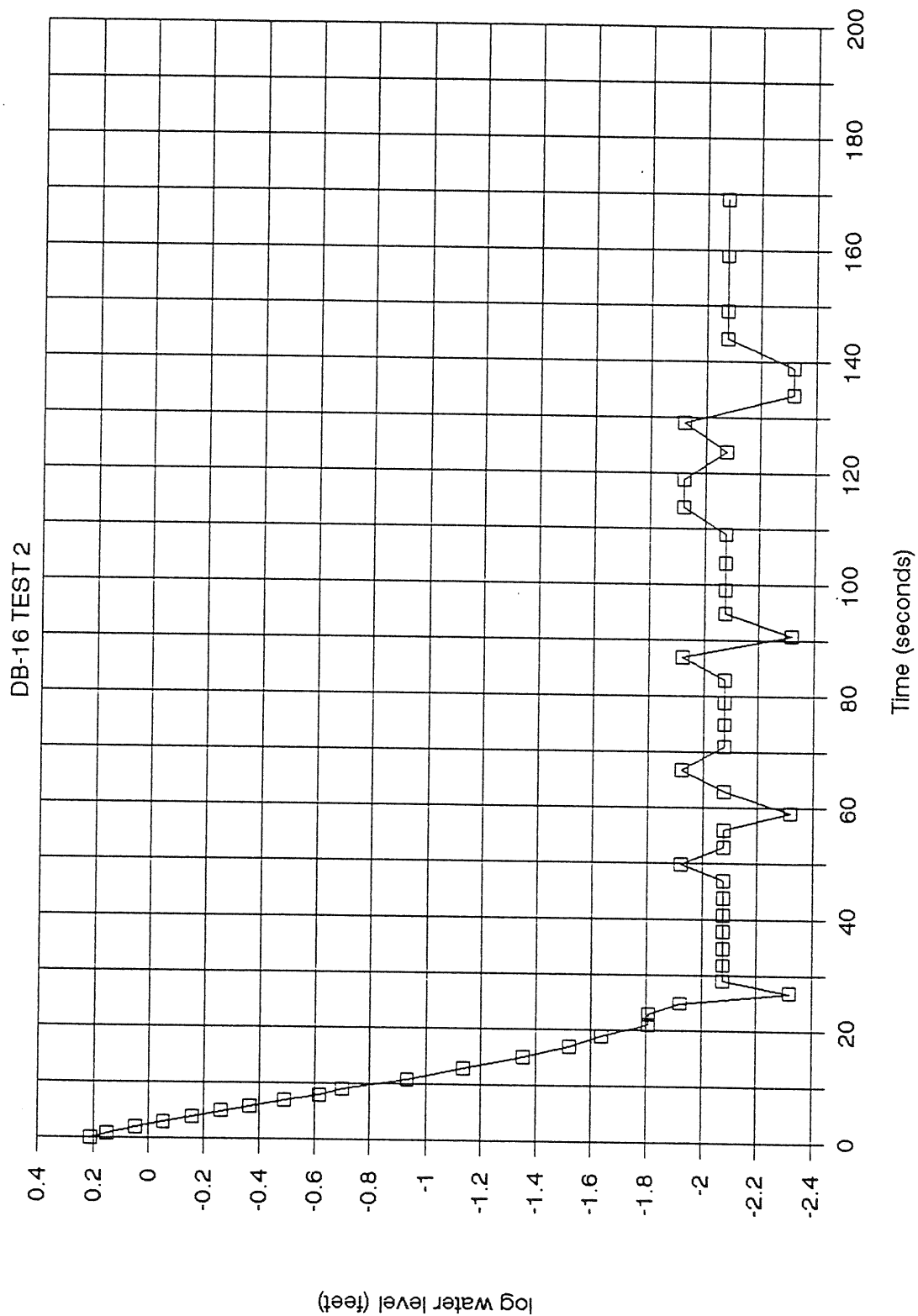


# LAILAW WASTE SYSTEM



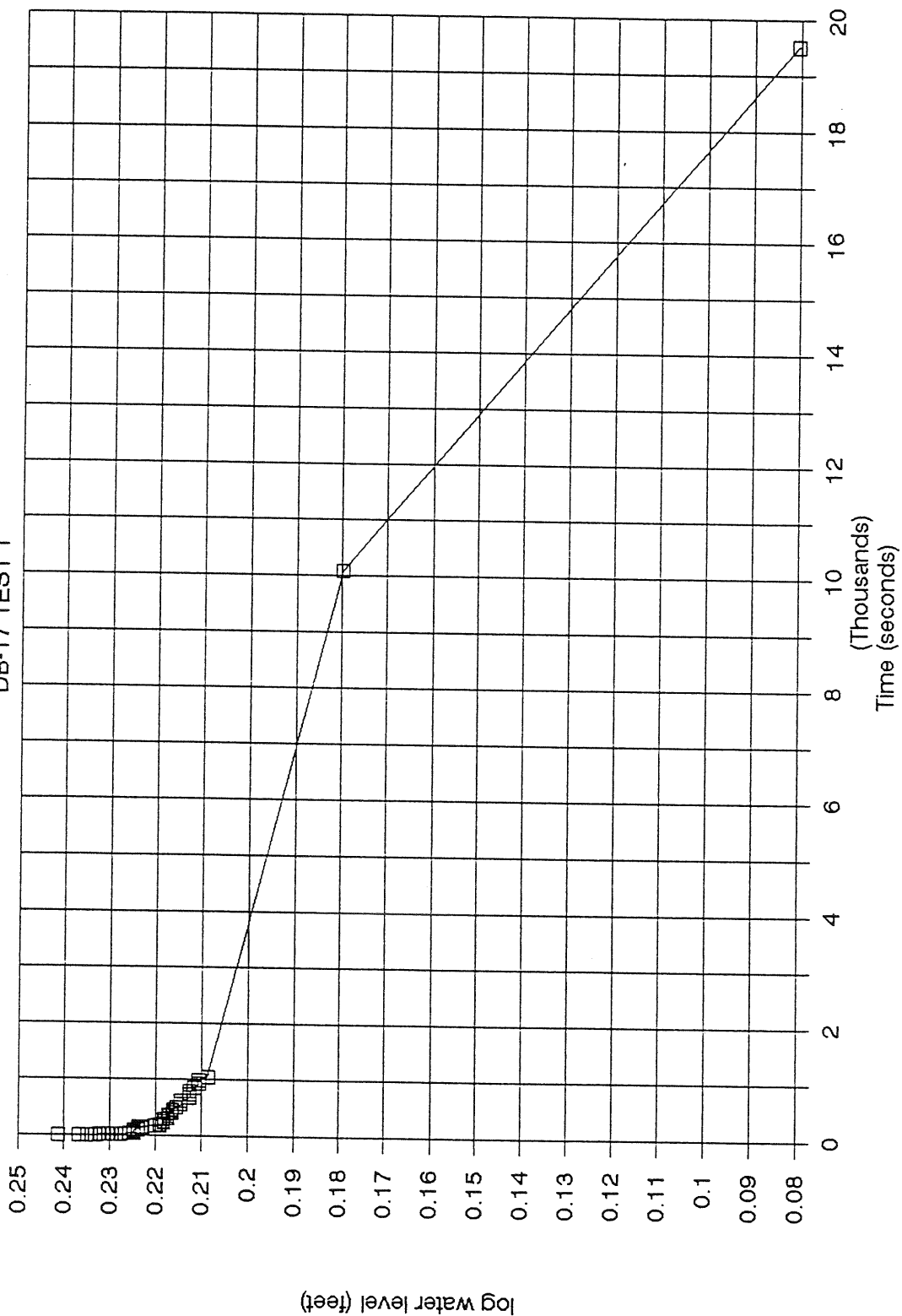


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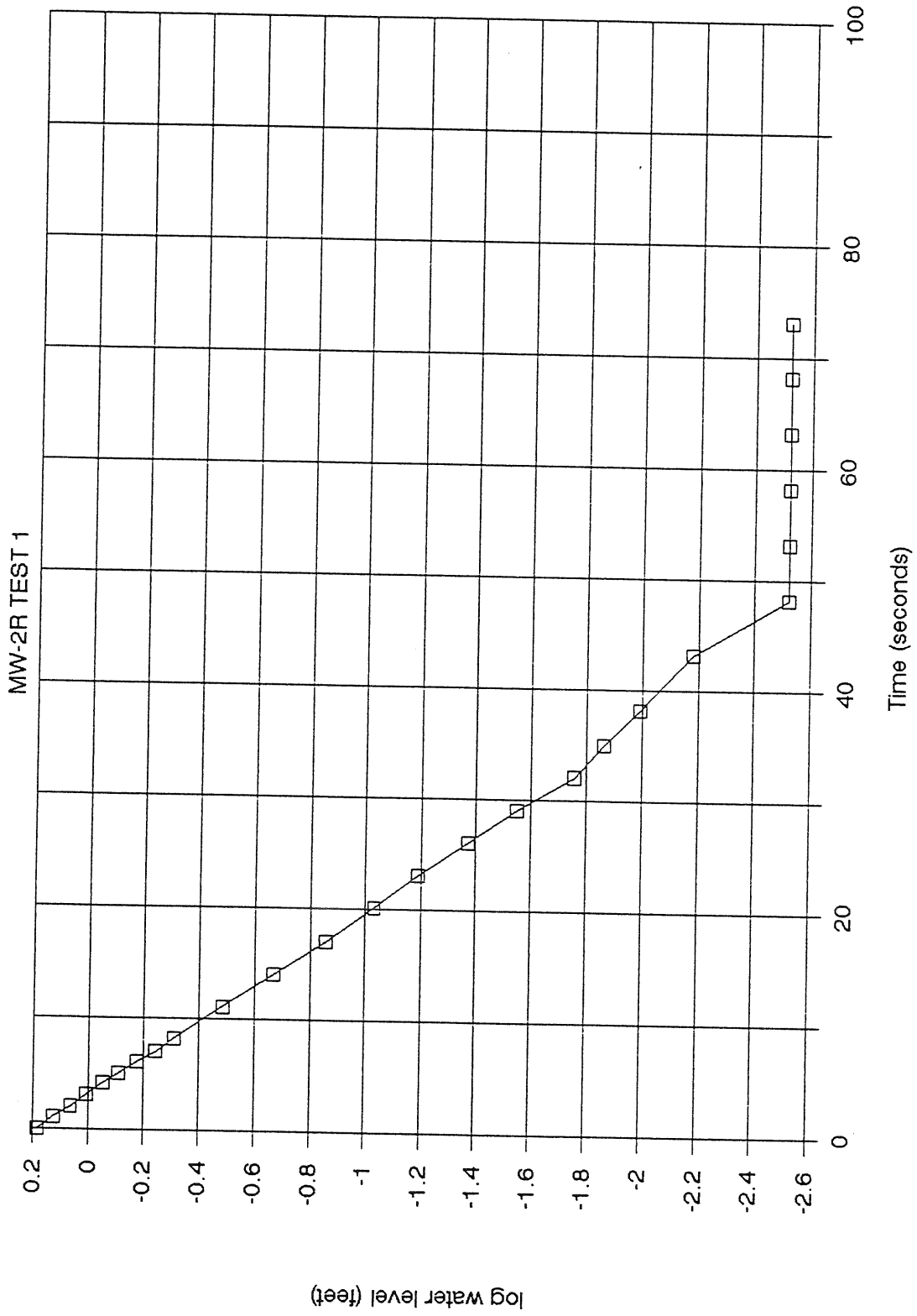


# LAILAW WASTE SYSTEM

DB-17 TEST 1

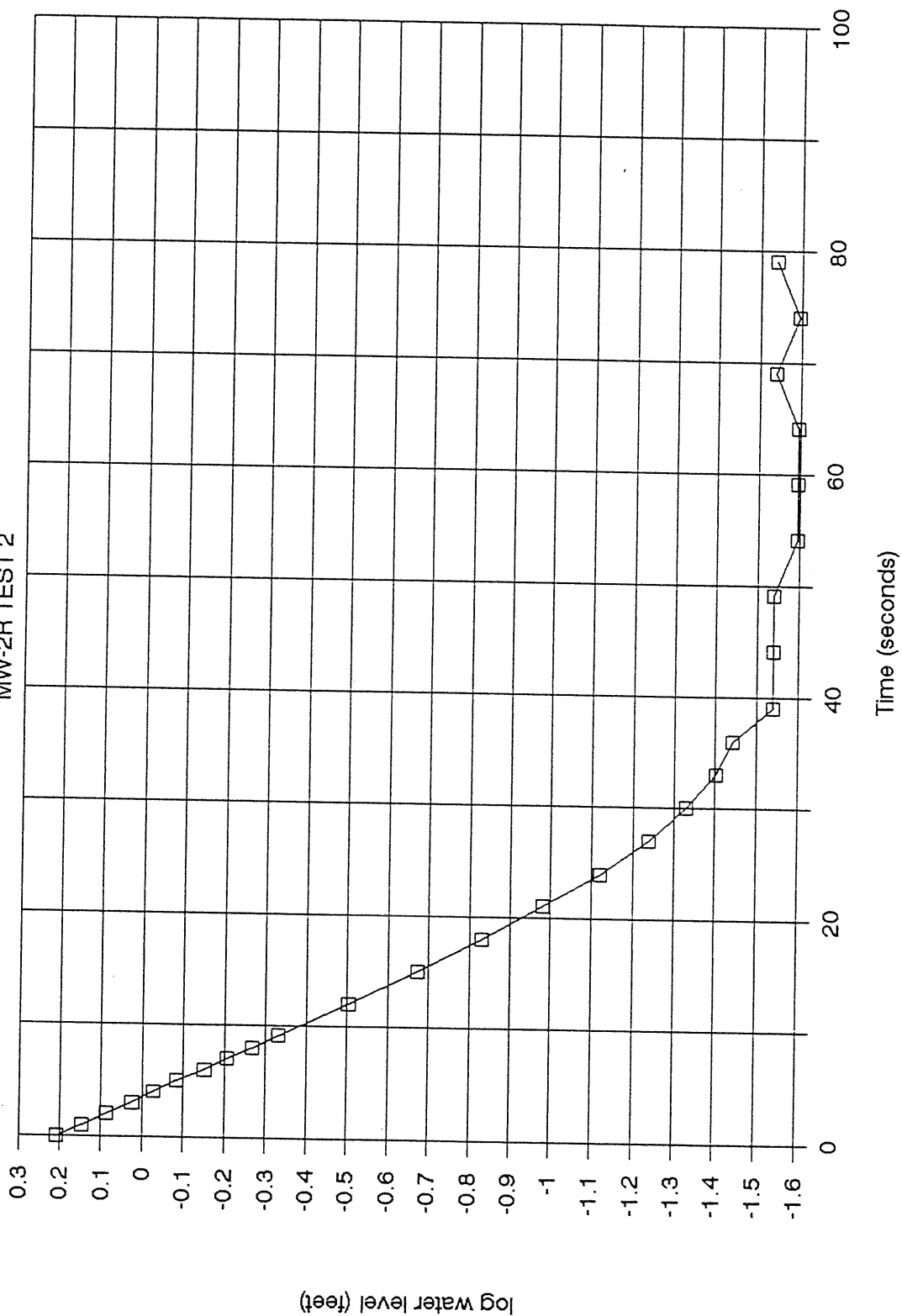


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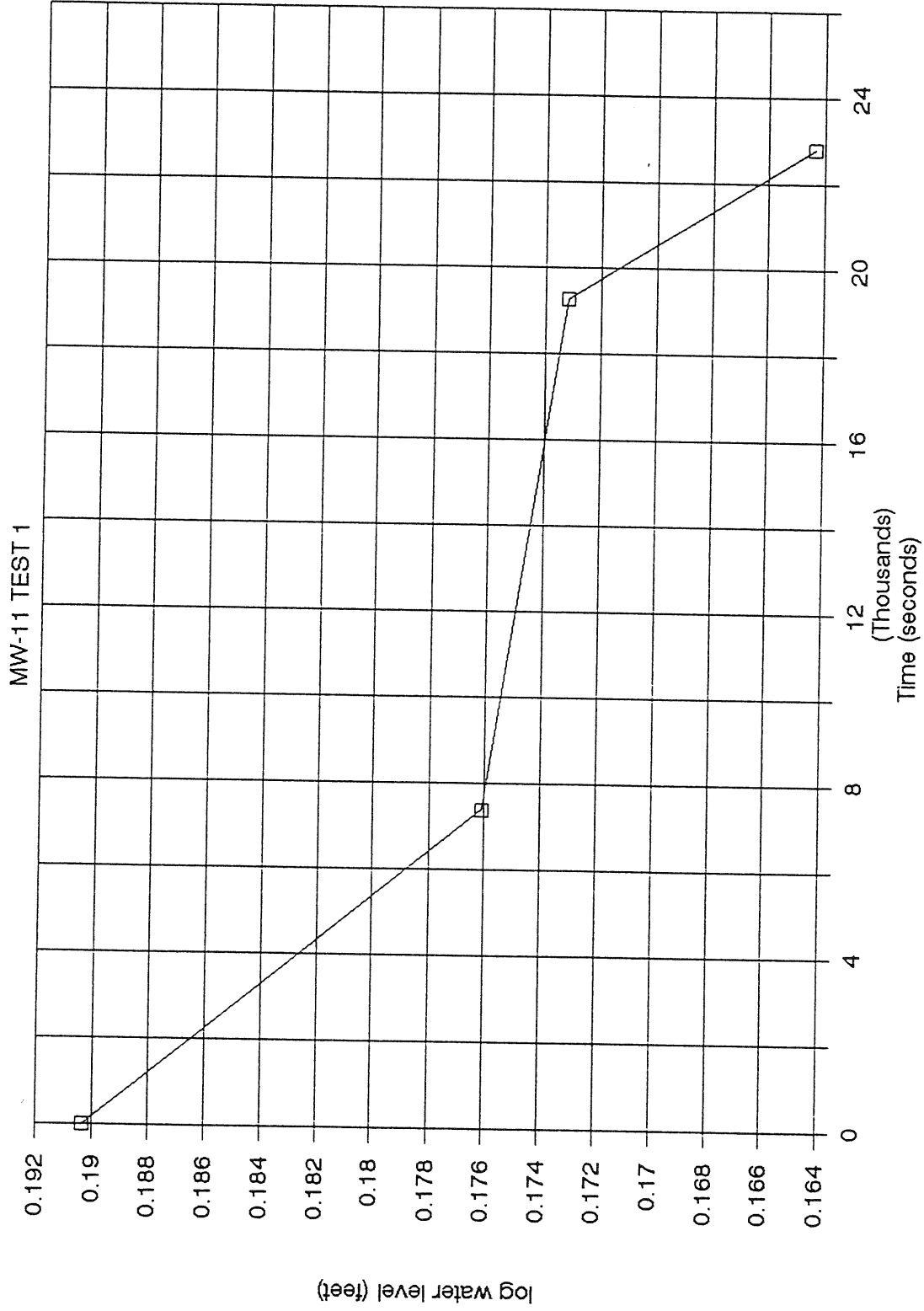


# LAIDLAW WASTE SYSTEM

MW-2R TEST 2



# LAILAW WASTE SYSTEM



# LAIDLAW WASTE SYSTEM

